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Thermogen I, LLC	**Departmental**
Penobscot County	**Findings of Fact and Order**
Millinocket, Maine	**New Source Review**
A-1072-77-3-A	**NSR #2**

FINDINGS OF FACT

After review of the air emissions license amendment application, staff investigation reports and other documents in the applicant's file in the Bureau of Air Quality, pursuant to 38 Maine Revised Statutes Annotated (M.R.S.A.), §344 and §590, the Maine Department of Environmental Protection (Department) finds the following facts:

I. REGISTRATION

A. Introduction

Thermogen I, LLC (Thermogen) has submitted an application to construct and operate an advanced biofuel pellet manufacturing facility in Millinocket, Maine. The proposed project will utilize steam thermal treatment technology to produce pellets. The pellets will be a renewable-based fuel to be co-fired with coal or used as a coal replacement. Maximum annual production of the biofuel pellets is expected to be approximately 387,800 oven dried tons per year.

The current proposal is for a different manufacturing technology and a higher overall production rate than what was addressed in major source air emission license A-1072-77-1-N issued to Thermogen on September 24, 2012. Air emission license A-1072-7-1-N included a similar project using a proposed torrefaction process to produce torrefied wood pellets from woody biomass, with a subsequent amendment issued to address changes to the proposed main stack; however, Thermogen has modified the originally proposed torrefication (microwave-based technology) project to increase the plant's design capacity and to incorporate steam thermal treatment technology.

The equipment addressed in this license will be located at 1 Katahdin Ave, Millinocket, Maine. The facility will be on leased property within the Great Northern Paper Company West Mill site.

B. Emission Equipment

The following equipment is addressed in this air emission license:

Fuel Burning Equipment

Equipment	Maximum Input Capacity (MMBtu/hr)	Maximum Firing Rate	Fuel Type	Date of Manuf.	Pollution Control Equipment	Stack #
Burners for Rotary Dryer	160	8.5 ODT/hr	Dry sawdust/ Pulverized wood	TBD	WESP and RTO	1
	30	326 gal/hr	Propane	TBD		
		30,000 scf/hr	CNG			
Steam Boiler	42.6	41,764 scf/hr	Natural gas	TBD	Low NO_X burner, FGR	2
RTO	25 (start-up)	25,510 scf/hr	CNG	TBD	-	1
	4 (normal operation)	3922 scf/hr				

Table notes: MMBtu/hr = million British Thermal Units per hour
ODT/hr = oven dried tons per hour
scf/hr = standard cubic feet per hour
TBD = to be determined
WESP = wet electrostatic precipitator
RTO = regenerative thermal oxidizer
FGR = flue gas recirculation
CNG = compressed natural gas

Generator

Equipment	Kilowatt (kW)	Maximum Input Capacity (MMBtu/hr)	Firing Rate (gal/hr)	Fuel Type, % sulfur	Date of Manuf.
Emergency Generator	250	2.68	19.1	Distillate, 0.0015%	TBD

Process Equipment

Equipment	Raw Material Process Rate (ODT/yr)	Pollution Control Equipment	Stack #
Rotary Dryer	458,000	WESP and RTO	1
Thermal Treatment Process	379,483	WESP and RTO	1
Fuel Hammermill Aspiration/Pneumatic Transfer (burner fuel system)	71,069	Fabric Filter	10
Pellet System Coolers 1 and 2	387,805	High Efficiency Cyclone	3 and 4
Dry Chips Pneumatics Transfer System (from Dry Chip Silo to Thermal Treatment System)	379,483	Fabric Filter	9
Pellet Mill Aspiration Transfer (from Pellet Mills to Pulverized Wood Burner)	387,805	Fabric Filter, WESP and RTO	1
Pellet System Fines Transfer (recirculating from Pellet Screen back into Pellet Mills)	387,805	Fabric Filter	11

Table note: ODT/yr = oven dried tons per year

C. Application Classification

A source is considered major or minor based on whether or not expected emission increases exceed the "Significant Emission" levels as defined in the Department's *Definitions Regulation*, 06-096 CMR 100 (as amended). Although this application is for the modification of a previous air emission license, construction of the previously licensed project never commenced and there is no existing stationary source to modify; therefore, the licensed emissions for this application are compared to the 'Significant Emission' levels, as presented below:

Pollutant	Future License (TPY)	Significant Emission Levels
PM	37.37	100
PM_{10}	16.78	100
$PM_{2.5}$	15.63	100
SO_2	12.11	100
NO_x	98.9	100
CO	60.74	100
VOC	**85.02**	50
CO_2e	**118,675**	100,000

Table Notes - The data in the above table was based on the following:

- Annual capacity factor of 95%, equaling 8322 hours
- Burner size of 160 MMBtu/hr with normal burner operating rate of 115 MMBtu/hr
- Dryer Capacity 55.10 oven dried ton/hr
- Control efficiencies: WESP PM = 96%, RTO CO = 70%, RTO VOC = 97%, Pellet Cooler Cyclone = 95%

Thermogen is classified as a major source for VOC and CO_2e and has been processed through *Major and Minor Source Air Emission License Regulations*, 06-096 CMR 115, (as amended). Thermogen is also considered a major source for hazardous air pollutants (HAPs).

As part of the application submittal process, a public information meeting was held in Millinocket on April 10, 2014, and the Public Notice of Intent to File was published in the Bangor Daily News on May 15, 2014. The Federal Land Managers (FLMs) representatives from Acadia National Park, Moosehorn National Wildlife Refuge, Roosevelt Campobello International Park, and Presidential Range/Dry River/Great Gulf Wilderness Area were notified of the project. This notification included a project summary, distances from the source to each of the Class I areas and the magnitude of proposed emissions increases on a pollutant-by-pollutant basis. In June 2014, several FLM representatives responded with determinations that Class I Air Quality Related Values (AQRV) analyses would not be required.

Thermogen shall apply for a Part 70 license under Part 70 Air Emission License Regulation, 06-096 CMR 140, Section 3 (as amended), within 12 months of commencing operation, as provided in 40 CFR Part 70.5.

II. BEST PRACTICAL TREATMENT (BPT)

A. Introduction

In order to receive a license, the applicant must control emissions from each unit to a level considered by the Department to represent Best Practical Treatment (BPT), as defined in *Definitions Regulation*, 06-096 CMR 100 (as amended). Separate control requirement categories exist for new and existing equipment.

BPT for new sources and modifications requires a demonstration that emissions are receiving Best Available Control Technology (BACT), as defined in 06-096 CMR 100 (as amended). BACT is a top-down approach to selecting air emission controls considering economic, environmental and energy impacts.

Based on projected emissions, a Lowest Achievable Emission Rate (LAER) analysis, as defined in 06-096 CMR 100 (as amended), was required for VOCs.

B. <u>Process Description</u>

The manufacturing facility proposed by Themogen will process up to 458,000 oven-dried tons per year of wood chips, equivalent to approximately 833,000 tons as received to produce pellets. The biomass wood chips will consist of low grade fiber from the portions of the tree that are not suitable for dimensional lumber or pulp chips. The approximately 45% moisture content wood chips will arrive via truck and will be unloaded onto a paved storage pad using two truck dumpers and a front end loader. From the storage area, the biomass will be transported by covered conveyor to two hammermills which will produce chips sized ½ inch or less. From the hammermills, the chips will be transported via another covered conveyer to a wet chip storage silo and into a metering bin, then into the Rotary Dryer.

The single-pass Rotary Dryer will dehydrate the wet wood chips to a moisture content of approximately 5%. A pulverized wood burner will provide direct heat for the Rotary Dryer, with a small amount of propane or compressed natural gas used for startup. After the Rotary Dryer, a bank of four cyclones will separate the dry wood chips and exhaust gases. A portion of the exhaust gases will be recirculated back through the dryer and the remainder of the exhaust gas will be routed to a wet electrostatic precipitator (WESP) followed by a regenerative thermal oxidizer (RTO) prior to exhausting to the atmosphere. The dry chips from the cyclones will be directed to a wood chip storage silo. From the storage silo, a small portion of dried chips will be directed to two (2) hammermills to be reduced in size for use as fuel in the Rotary Dryer's pulverized wood burner.

The majority of the dried wood chips will be pneumatically conveyed to the steam Thermal Treatment Process area where chips will be treated with high pressure steam in one of six thermal treatment pressure vessels. After being 'cooked' for several minutes, the chips will be discharged from the pressure vessels and flash depressurized into a blow tank, breaking up the wood structure. The exhaust from the blow tank will be routed through two high-efficiency cyclones to remove entrained particles (fiber) and from there will exhaust through the WESP and RTO. Steam for the Thermal Treatment Process will be supplied by a compressed natural gas boiler.

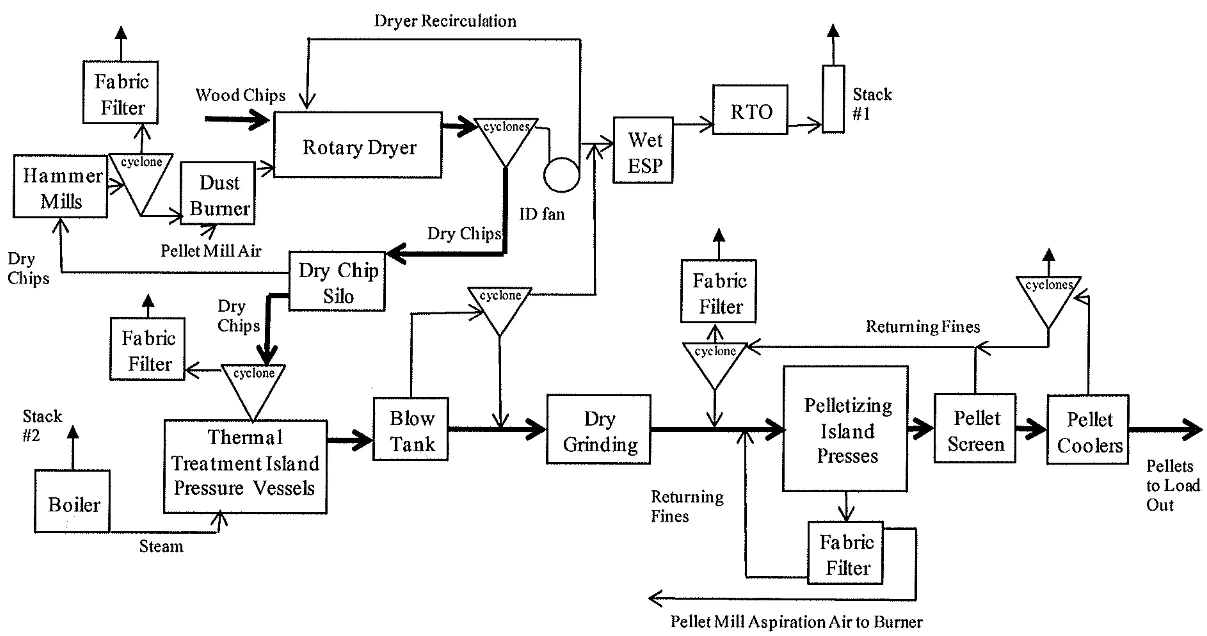
Following the Thermal Treatment Process, the biomass will pass through grinders, then through the Pellet Mills and Pellet Coolers. The six Pellet Mills will have aspiration air drawn from them and routed to the Rotary Dryer burner to be used as combustion air. The two Pellet Coolers will have a larger volume of air drawn from them and directed to high-efficiency cyclones for particulate control.

From the Pellet Coolers, the pellets will pass through a screening process to remove fines and then will be transported by covered conveyor to a loadout station for rail shipment.

The Thermogen facility will be producing a pellet with unique characteristics of increased energy density (as compared to standard 'white' wood pellets), water resistance and durability. Currently, Zilkha Biomass operates a smaller-scale plant of similar design in Crockett, Texas and is constructing a plant of comparable size to the Thermogen facility in Selma, Alabama. Zilkha Biomass is the licensor of the steam Thermal Treatment Process.

The following is a general overall process flow diagram for the proposed project:

Process Flow Diagram for the Proposed Thermogen Facility



C. <u>Rotary Dryer with Pulverized Wood Burner and Thermal Treatment Process</u>

The main process equipment at the facility will consist of the Rotary Dryer with a pulverized wood burner, followed by the Thermal Treatment Process. The Rotary Dryer will reduce chip moisture to approximately 5%. The dryer burner is to be rated at 160 MMBtu/hr (8.5 ODT/hr) and will utilize a portion of the chips from the Rotary Dryer as fuel, with the majority of chips continuing on to be processed into pellets. The chips allocated for fuel will be routed via pneumatic conveyor from the dry chip silo to the Hammermills and will be fed into the pulverized wood burner. Additional input to the pulverized wood burner includes aspiration air from the Pellet Mills to be used as combustion air and/or makeup air. In addition to utilizing the Pellet Mill aspiration air for burner operations, the aspiration air will end up being controlled by the control equipment on the Rotary Dryer. A startup burner with an expected rating of 30 MMBtu/hr will utilize either propane or compressed natural gas (CNG) as supplemental start-up fuel. It is estimated that it will take approximately 4 hours from cold start for the burner to be switched to pulverized wood.

The Thermal Treatment Process will consist of six thermal treatment pressure vessels and a blow tank. The dried chips will be conveyed from the dry chip silo to the thermal treatment area. The chips will be treated with high pressure steam for several minutes in each of the vessels operating in a sequential batch manner, then will be discharged and flash depressurized into a blow tank. The blow tank exhaust will first be routed through two high-efficiency cyclones to remove the majority of any entrained wood particles and the exhaust will then be further controlled.

The emissions from the Rotary Dryer and Thermal Treatment Process will be routed to the same pollution control equipment. The selection of the pollution control equipment was specific to this type of manufacturing process due to high moisture levels and the presence of both condensable and filterable particulate matter. Emissions from the Rotary Dryer and the Thermal Treatment Process have been proposed to be controlled by a wet electrostatic precipitator (WESP) and regenerative thermal oxidizer (RTO) prior to exiting Stack #1 at 150 feet above ground level. The RTO will utilize compressed natural gas as supplemental fuel to maintain the unit's combustion temperature. The maximum input rating of the RTO's burner will be 25 MMBtu/hr for preheating the oxidizer from a cold start; the normal usage rating will be 4 MMBtu/hr on an annual average basis.

1. BACT/LAER/MACT Findings

Thermogen submitted a Best Available Control Technology (BACT) analysis addressing emissions and controls for PM, PM_{10}, $PM_{2.5}$, NO_X, SO_2, CO, and greenhouse gases (GHGs). A Lowest Achievable Emission Rate (LAER) analysis was submitted addressing VOCs. EPA's RACT/BACT/LAER Clearinghouse (RBLC), New Jersey State-of-the Art Manual, Massachusetts BACT guidance, South Coast Air Quality Management District BACT guidance, and permits for facilities in the northeast with similar equipment were reviewed.

The BACT procedure consists of a five step process: identify control technologies, eliminate technically infeasible options, rank remaining control technologies by control effectiveness, evaluate the most effective controls and document results, including case-by-case consideration of energy, environmental, and economic impacts, and an evaluation of the next most effective control option if the top option is not selected as BACT, and select BACT, the most effective control option not rejected.

LAER is the more stringent rate of emissions based on (1) the most stringent emission limitation contained in the implementation plan of any State for that class or category of source, unless the owner or operator of the proposed source demonstrates that those limitations are not achievable; or (2) the most stringent emission limitation which is achieved in practice by that class or category of source, whichever is more stringent.

Thermogen is a major source of HAPs and is required to implement Maximum Achievable Control Technology (MACT). MACT is defined in 06-096 CMR 100 as "...the emission limitation pursuant to Section 112 of the CAA which is not less stringent than the emission limitation achieved in practice by the best controlled similar source, and which reflects the maximum degree of reduction in emissions of hazardous air pollutants (including a prohibition on such emissions, where achievable) that the EPA, or the Department, taking into consideration the cost of achieving such emission reduction, and any non-air quality health and environmental impacts and energy requirements, determines is achievable by sources in the category or subcategory to which the standard applies."

The Thermogen process will produce a unique pellet product, but the drying process to be utilized is similar to biomass dryers used in the production of standard wood pellets and in the production of oriented strand board (OSB). Pellet production and OSB production facilities were included in the BACT/LAER review.

The following table contains the results of the review of the RBLC and similar source licenses:

Summary of Biomass Burners and Dryers BACT/LAER Review

Facility	State	Capacity & Description	Control Methods	Emission Limits				
				PM_{10}	NO_X	SO_2	CO	VOC
Beaver Wood Energy Fair Haven, LLC	VT	30 MMBtu/hr, 11 ODT wood fired dryer for pellet mill	Cyclone & Baghouse	0.2 lb/ODT	0.35 lb/MMBtu	0.025 lb/MMBtu	0.25 lb/MMBtu	0.35 lb/MMBtu
Interna-tional Biofuels	VA	77 MMBtu/hr, wood-fired heater & rotary dryer for pellet mill	Settling chambers, cyclones, thermal oxidizer	6.96 lb/hr	0.22 lb/MMBtu	3.9 lb/hr	0.19 lb/MMBtu	37.8 lb/hr
Great Northern Pellets, LLC	NH	5 MMBtu/hr, 3.26 ODT wood fired dryer	Cyclones	2.76 lb/ODT	0.33 lb/MMBtu	-	-	-
Geneva Wood Fuels, LLC	ME	40 MMBtu/hr, wood fired dryer	Multiple Cyclones and Good Comb-ustion Practices	8.5 lb/hr	0.27 lb/MMBtu	0.047 lb/MMBtu	0.27 lb/MMBtu	9.7 lb/hr

Facility	State	Capacity & Description	Control Methods	Emission Limits				
				PM_{10}	NO_X	SO_2	CO	VOC
Deposit Wood Pellet LLC	NY	15 ODT/hr wood fired rotary kiln dryer	Multiple Cyclones	0.05 gr/cf	-	-	-	0.57 lb/ODT
Maine Woods Pellet Company	ME	50 MMBtu/hr wood fired dryer	Cyclones & Wet Scrubber	8.5 lb/hr	12.3 tpy	12.5 tpy	37 tpy	12.5 lb/hr
Presby North Country Wood Pellets, Inc.	NH	20 MMBtu/hr, 8 ODT/hr wood fired dryer	Multiple Cyclones	2.06 lb/ODT	-	-	-	-
Woodstone NY, LLC	NY	38 MMBtu/hr, 13.2 ODT/hr wood fired rotary kiln dryer	Multiple Cyclones	0.05 gr/cf	0.59 lb/MMBtu	-	-	0.85 lb/ODT
Corinth Wood Pellets	ME	20 MMBtu/hr, 11.1 ODT/hr wood fired rotary dryer	Two Cyclones, Good Comb-ustion Practices	2.3 lb/ODT softwood; 2.70 lb/ODT hardwood	0.29 lb/MMBtu	0.05 lb/ODT	-	2.09 lb/ODT softwood; 1.0 lb/ODT hardwood
New England Wood Pellet, LLC	NH	40 MMBtu/hr, 10.2 ODT/hr wood fired rotary dryer	Multiple Cyclones	1.18 lb/ODT	-	-	-	-
Schuyler Wood Pellet LLC	NY	50 MMBtu/hr, 15 ODT/hr wood fired rotary kiln dryer	Multiple Cyclones & 1700˚F Dryer Inlet Temp.	1.40 lb/ODT	-	-	-	0.70 lb/ODT
Eureka Pellet Mill	MT	35 MMBtu/hr 9 ODT/hr Coen Burner, triple pass rotary dryer	Low NO_X, air staging burner, cyclone, fabric filter	0.2 lb/ODT	0.42 lb/MMBtu	-	0.35 lb/MMBtu	0.69 lb/ODT
Martco, LP	LA	each 174 MMBtu/hr 24.1 ODT/hr (3) wood fired rotary dryers	RTO, Venturi Scrubber, WESP, low NO_X, water injection	0.08 lb/ODT (nat'l gas)	0.118 lb/MMBtu (nat'l gas)	0.17 lb/ODT	2.11 lb/ODT	0.25 lb/ODT

Facility	State	Capacity & Description	Control Methods	Emission Limits				
				PM_{10}	NO_X	SO_2	CO	VOC
Louisiana-Pacific Co, Sagola Mill	MI	310,000 ton/yr (3) flake dryers with process cyclone	Low NO_X, RTO, WESP, Cyclone	0.007 gr/dscf	0.62 lb/ton product hardwood; 1.24 lb/ton softwood	-	3.64 lb/ton product hardwood; 4.39 lb/ton softwood	0.29 lb/ton product hardwood; 0.37 lb/ton softwood
Louisiana-Pacific Co, Clarke County	AL	188 MMBtu/hr 42.5 ODT/hr Bark burner/dryer	WESP, RTO, good design & operation	1.19 lb/ODT (filterable)	0.28 lb/MMBtu	0.11 lb/ODT	0.47 lb/ODT	0.55 lb/ODT
Paragon Panels of Alabama, LLC	AL	151 MMsf/yr Wood fiber prep and drying	Two RTOs	20.57 lb/hr	80 lb/hr	-	-	27.35 lb/hr
Norbord	GA	52 ODT/hr (2) wood flake dryers	WESP	0.55 lb/ODT	0.28 lb/MMBtu	-	0.28 lb/MMBtu	1.2 lb/ODT
Louisiana-Pacific Co. Pacific Hayward	WI	(4) Dryers, rotary or single pass	Thermal Oxidizer, WESP, high efficiency cyclones	6.10 lb/hr (per unit)	21.9 lb/hr (per unit)	-	110.90 lb/hr (per unit)	13.05 lb/hr (one unit);9.79 lb/hr (second unit)
Louisiana-Pacific Co. Carhage oriented strandboard mill	TX	(2) Dryer RTOs	WESP, RTOs	7.34 lb/hr (filterable)	2.68 lb/hr	-	149.14 lb/hr	4.20 lb/hr
Louisiana-Pacific Co. Jasper oriented strandboard mill	TX	(2) Dryer RTOs	WESP, RTOs	7.17 lb/hr	81.75 lb/hr	2.18 lb/hr	186.43 lb/hr	5.25 lb/hr
Georgia-Pacific oriented strandboard facility	AR	each 40 MMBtu/hr 600 MMsf/yr (5) Rotary Chip Dryers	RTO, Multi-clone	18.82 lb/hr (per unit)	0.37 lb/MMBtu	-	1.3 lb/MMBtu	31.9 lb/hr (per unit)
Weyerhaeuser	MI	54 ODT/hr total 40 MMBtu/hr each Dryers	RTO, WESP	0.55 lb/ODT (filterable)	23.15 lb/hr (inc. nat'l gas)	0.01 lb/ODT	0.92 lb/MMBtu	0.34 lb/ODT

Facility	State	Capacity & Description	Control Methods	Emission Limits				
				PM_{10}	NO_X	SO_2	CO	VOC
Georgia-Pacific oriented strandboard facility	AR	475 MMsc/yr per unit (5) OSB dryers	RTO	14.89 lb/hr (per unit)	14.66 lb/hr (per unit)	-	6.72 lb/hr (per unit)	25.25 lb/hr (per unit)
Potlatch Corp	LA	16.5 ODT/hr Wood wafer dryer, triple pass rotary drum	WESP	0.36 lb/ton	0.5 lb/ton	-	0.36 lb/ton	0.48 lb/ton
Louisiana-Pacific Co Urania Plant	LA	7.5 ODT/hr (2) flash tube dryers	RTO	1.93 lb/ton (filterable)	4.31 lb/ton	-	1.31 lb/ton	0.70 lb/ton

The data obtained from the RBLC and similar sources license review, along with information on the economic impact, technical feasibility, and environmental impact of various control options, was used to determine the available control technologies and corresponding levels of control for the emissions from the Rotary Dryer/Pulverized Wood burner and the Thermal Treatment Process.

The following summarizes the BACT/LAER/MACT findings for the Rotary Dryer/Pulverized Wood Burner and Thermal Treatment Process:

a. $PM/PM_{10}/PM_{2.5}$

Particulate matter (PM) emissions from biomass dryers are primarily generated through evaporation of moisture which contains particulates. In addition, PM can be generated through incomplete combustion of fuel and non-combustible material in the fuel. PM emissions can also be formed due to condensation. The quantity of PM emissions from a biomass dryer can be dependent upon wood species being dried, dryer temperature, fuel used in the burner, and additional factors such as seasonal moisture variations and wood storage time. The Thermal Treatment Process is also a source of PM emissions, resulting from breaking apart the chips by steam 'cooking' and then flash depressurizing into the blow tank. The pellet mill aspiration system exhaust used in the Pulverized Wood Burner on the Rotary Dryer will also contain PM.

Control options identified for particulate matter emissions from the Rotary Dryer/Pulverized Wood Burner and Thermal Treatment Process include electrostatic precipitators (ESPs), fabric filters, thermal oxidizers, wet scrubbers, exhaust gas recycle, cyclone(s) and good combustion/operation practices.

Fabric filters collect particulate matter on the surface of filter bags which are periodically cleaned or replaced. Collection efficiencies can be greater than 99%, depending on the size range of the particulate matter, the filter material, and air flow. Baghouses can theoretically control PM emissions from wood dryers, but moisture and condensable organic matter have a detrimental impact on operation performance, resulting in blinding of the fabric filter. Based on the high levels of moisture and condensable organics in the dryer exhaust and the high levels of moisture in the thermal treatment exhaust, Thermogen considered fabric filters technically infeasible and eliminated them from further consideration.

Thermal oxidizers destroy condensable PM by burning the exhaust gas at high temperatures. Carbon monoxide (CO) emissions can also be reduced by oxidizing the CO in the exhaust to carbon dioxide (CO_2). Regenerative thermal oxidizers (RTOs) are designed to preheat the inlet emission stream with heat recovered from the oxidizer's exhaust gases. The inlet gas stream passes through preheated beds packed with ceramic media. An auxiliary gas burner is used to obtain incineration temperatures between 1450°F and 1600°F over a sufficient gas residence time to obtain complete combustion. The combusted gas exhaust then goes through a cooled ceramic bed where heat is extracted. To reduce auxiliary fuel requirements, the flow is reversed through the beds to transfer the heat from the combustion exhaust air to the gases to be treated. For processes with large exhaust flows, RTOs are often used because of the efficient usage of heat recovery and the ability to be scaled up to large sizes. Filterable particulate must be minimized prior to the RTO. Thermogen has determined that an RTO is a feasible control option for the proposed facility and has been selected as part of the BACT strategy.

Electrostatic Precipitators (ESPs) consist of utilizing high voltage to charge particles in the exhaust stream and to oppositely charge collection surfaces. As the charged exhaust stream goes through the ESP, the particles are attracted to the collection surfaces where they accumulate, are removed by a rapping process, and are collected in hoppers. Wet ESPs pre-quench the exhaust stream to cool and saturate the gases prior to entering the ESP. The wet ESP collects particles and droplets that can be electrostatically charged and the collection surfaced is washed down with water to remove the collected particles. The wet ESP technology has been determined to be feasible and has been selected as part of the BACT strategy for the proposed Thermogen process.

Wet scrubbers consist of using particle inertia, condensation, and absorption to transfer particles from the gas stream to a liquid stream. A fiber bed or packed bed media is used with liquid circulation, or a venturi is used where the particles impinge on a wetted surface. The PM is stripped out when the exhaust gases pass through the wetted media. Wet scrubbers result in a significant wastewater stream and if the exhaust stream contains a large amount of condensable or non-soluble particles, the packing in the scrubbers can become fouled. In a venturi scrubber, the particles are collected by a liquid introduced at or before the venturi throat. Although a venturi scrubber is technically feasible, this type of scrubber is less effective at controlling small particles than either ESPs or fabric filters. In addition, there are environmental considerations of make-up water requirements and waste disposal. Thermogen did not consider scrubbers as the best control option, given the efficiency and environmental factors associated with scrubber operations.

Exhaust gas recycle typically involves recycling exhaust gases from a flue stack into an oversized combustion unit designed to accommodate up to 100% recirculation of exhaust gases. The recirculated dryer exhaust is mixed with combustion air and exposed directly to the burner flame where organic particulate matter emissions are incinerated. Thermogen's proposed design is for an integrated air pollution control system to control emissions from not only the dryer, but other process sources as well. Exhaust gas recycle would only control emissions from the burner and dryer, and was not considered further.

Cyclones utilize centripetal force to separate particles from gas streams. Cyclones are commonly constructed of sheet metal, have relatively low capital cost, low operating costs, no moving parts, and enable recovery and reuse of particulate matter contained in exhaust streams. Cyclones are normally an integral part of biomass dryer processes and can also be used as a particulate control device in many applications, especially where relatively large particles need to be collected. Although cyclones will be used in several locations in the Rotary Dryer and Steam Thermal Treatment Process areas at the Thermogen facility, they will mainly be used to separate product from an air stream. The use of cyclones as pollution control equipment has been determined to be feasible, but was not considered one of the best control options on an efficiency basis, especially for very small particles.

Good combustion practices can reduce products of incomplete combustion, including particulate matter. The use of a new, efficient, clean burning burner and good combustion practices will be part of the BACT control strategy for Thermogen.

The following summarizes the PM control technology rankings:

Dryer System PM/PM_{10} Control Technology Rankings

Control Technology	% PM/PM_{10} Control	Technical Feasibility
Regenerative Thermal Oxidizer ***SELECTED***	98+	Feasible
Wet Electrostatic Precipitator ***SELECTED***	96%	Feasible

Control Technology	% PM/PM_{10} Control	Technical Feasibility
Fabric Filter	80-99%	Infeasible
Wet Scrubber	50+	Feasible (but with efficiency and environmental considerations)
Exhaust Gas Recycle (thermal oxidation for portion of gas stream)	40-60	Feasible for the dryer only
Cyclone(s)	Variable	Feasible
Good Combustion Practices ***SELECTED***	General Minimization of Emissions	Feasible

BACT for $PM/PM_{10}/PM_{2.5}$ emissions from the Rotary Dryer/Pulverized Wood Burner and Thermal Treatment Process is the use of a WESP combined with an RTO, in addition to good combustion and operating practices. The BACT particulate matter emissions limits are the following:

$PM/PM_{10}/PM_{2.5}$ BACT Emission Limits –
Rotary Dryer/Pulverized Wood Burner and Thermal Treatment Process

Pollutant	Stack #1 (post WESP and RTO)
PM (filterable)	3.85 lb/hr*
PM_{10} (total: filterable and condensable)	3.85 lb/hr*
$PM_{2.5}$ (total: filterable and condensable)	3.85 lb/hr*

* based on sum of: Rotary Dryer/Pulverized Wood Burner = 3.58 lb/hr
Thermal Treatment Process = 0.26 lb/hr
Pellet Mill Aspiration Air = 0.003 lb/hr

The PM/PM_{10} emission limits are more stringent than the particulate matter limit found in *General Process Source Particulate Emission Standard* 06-096 CMR 105 (as amended).

b. SO_2

Sulfur dioxide (SO_2) is formed from the combustion of fuel with sulfur present, resulting in oxidation of the sulfur compounds to sulfur oxides. Control options for SO_2 include removing the sulfur from the flue gas by add-on controls such as scrubbing, restricting the sulfur content of the fuel, or using low sulfur fuel. The wood fuel fired in the Pulverized Wood Burner is inherently a very low sulfur fuel. The use of propane gas or compressed natural gas for burner startup is also considered a low sulfur fuel. Additional sulfur controls are not justified.

BACT for SO_2 emissions from the Rotary Dryer/Pulverized Wood Burner and Thermal Treatment Process is the firing of clean wood material, the use of propane gas or compressed natural gas for burner startup, and the following emission limit:

SO_2 BACT Emission Limit –
Rotary Dryer/Pulverized Wood Burner and Thermal Treatment Process

Pollutant	Stack #1 (post WESP and RTO)
SO_2	4.0 lb/hr

c. NO_X

Fuel NO_X, thermal NO_X, and prompt NO_X are formed by three different mechanisms. Fuel NO_X is produced by oxidation of nitrogen in the fuel source, with higher nitrogen content fuel capable of producing greater amounts of NO_X. Thermal NO_X is formed from nitrogen (N_2) and oxygen (O_2) at temperatures above 3600°F. Prompt NO_X is formed from rapid reaction of N_2 with hydrocarbon radicals.

Add-on NO_X control options include selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR). Combustion control techniques for NO_X emission reductions include staged combustion, low excess air firing, flue gas recirculation, and combustion of clean fuels.

Add-on SCR and SNCR controls are primarily used on large industrial and utility boilers resulting in reduced NO_X emissions through the injection of urea or ammonia in the gas exhaust stream under specific temperature ranges.

SCR utilizes a catalyst to allow the reaction to occur at temperatures of 600°F-750°F. Due to possible particulate matter or condensables adhering to the catalytic surface, the catalyst must be located downstream of particulate matter control for biomass boilers resulting in a need to reheat the exhaust prior to the SCR equipment. No specific examples of SCR on biomass dryers were found and due to the use of a wet electrostatic precipitator for effective particulate control, the exhaust gas temperature from the precipitator would have to be raised by 250°F-300°F for the SCR to be effective. In addition, NO_X in the exhaust stream will be diluted since the particulate matter controls will serve multiple parts of the process, thereby reducing the control effectiveness of SCR. Based on the lack of examples of SCR installations on direct-fired biomass dryers, the need to reheat the exhaust, and the potential for less effective overall NO_X control for the operations as proposed, SCR was not considered a feasible control option.

SNCR consists of injecting the urea or ammonia where the exhaust gases are at a temperature of 1600°F-2100°F, without the use of a catalyst. NO_X reductions of 30-50% can be achieved, based on mixing and residence time. Successful utilization of SNCR has occurred in biomass boilers and cement kilns; however, SNCR was not considered as a feasible NO_X control option for the direct-fired biomass dryer emissions due to the low temperatures in the dryer.

Lower NO_X emissions can be achieved through combustion control techniques. New burner designs result in lower NO_X emissions by employing various features to reduce peak flame temperatures, reduce excess air at specific stages of combustion, and promote mixing. Flue gas recirculation can also be utilized to decrease the flame temperature by recirculating a portion of the flue gas back in to the combustion chamber. Combustion control techniques were considered feasible NO_X control options.

Combusting fuels with less fuel bound nitrogen results in lower emissions from fuel NO_X. Wood has a lower nitrogen content than most fuel oils, but a higher nitrogen content than natural gas or propane. The typical biomass nitrogen content is less than 0.1%, but up to 0.3% nitrogen content may be found in bark. For Thermogen's dryer system, using wood fuel is an option to minimize NO_X emissions. Switching to an even lower nitrogen content primary fuel is not a viable option based on the project's purpose and design, as well as the current on-site infrastructure which would necessitate numerous daily truck deliveries of propane or compressed natural gas. However, propane or CNG will be used for startup.

BACT for NO_X emissions from the Rotary Dryer/Pulverized Wood Burner and Thermal Treatment Process is the use of an advanced burner design in conjunction with FGR; firing biomass materials with a limited use of propane or CNG for burner startup; and the following emission limit:

NO_X BACT Emission Limit –
Rotary Dryer/Pulverized Wood Burner and Thermal Treatment Process

Pollutant	Stack #1 (post WESP and RTO)
NOx	30.72 lb/hr *

* based on sum of: Burner 0.191 lb/MMBtu x 160 MMBtu/hr = 30.56 lb/hr
RTO 0.04 lb/MMBtu x 4 MMBtu/hr = 0.16 lb/hr

d. CO

Carbon monoxide (CO) emissions are a result of incomplete combustion, due to conditions such as insufficient residence time or limited oxygen availability. CO emissions can be reduced through good combustion practices or add-on controls such as oxidation catalysts or thermal oxidizers.

An oxidation catalyst lowers the activation energy needed for CO to react with available oxygen in the exhaust to produce CO_2. In order to prevent the occurrence of particulate contamination in a biomass system, the oxidation catalyst would need to be located after the particulate matter control technology, similar to the NO_X SCR add-on control system. As also previously mentioned in the SCR discussion, the process exhaust gas would then need to be preheated a few hundred degrees prior to contact with the catalyst bed. Based on the associated need for a burner to reheat the exhaust gases and the biomass plugging potential, the oxidation catalyst was not considered a feasible option for controlling CO emissions for the Thermogen project.

Thermal oxidation reduces CO emissions in the flue gas with high temperature post combustion. A thermal oxidation system is normally not utilized for CO control alone. A thermal oxidation system will be used for VOC control, with the added benefit of being a feasible control option for CO.

Good combustion techniques can minimize CO emissions, including maintaining optimum combustion conditions within the system via optimization of residence time, temperature, and mixing; ensuring proper equipment maintenance; and proper operator training.

BACT for CO emissions from the Rotary Dryer/Pulverized Wood Burner and Steam Thermal Treatment Process is the use of thermal oxidation with a destruction efficiency of approximately 70%, good combustion practices, and the following emission limit:

CO BACT Emission Limits –
Rotary Dryer/Pulverized Wood Burner and Thermal Treatment Process

Pollutant	**Stack #1 (post WESP and RTO)**
CO	18.05 lb/hr

e. VOC

Volatile Organic Compounds (VOC) emissions from the Rotary Dryer/Pulverized Wood Burner and Thermal Treatment Process are subject to a Lowest Achievable

Control Technology (LAER) analysis, since VOC emissions from the facility are above the significant emission level and the facility is located in the Ozone Transport Region.

VOCs will be generated in the Thermogen process primarily through evaporation of the naturally occurring VOCs in the wood from the Rotary Dryer, the Thermal Treatment Process, and the Pellet Mills. The heavy organics may be emitted as condensables, with this condensable fraction counted as VOC or particulate matter, or both, depending on the measurement method and the flue gas conditions.

Options for controlling VOCs from processes similar to Thermogen's include condensation, adsorption, absorption, thermal oxidation, and wet electrostatic precipitators.

To utilize condensation as a VOC control method, the temperature of the exhaust stream is reduced below the saturation temperature of the organic materials in the waste stream. The effectiveness of the condensation control depends on the vapor pressure of the organic constituents, the organic concentration, and the non-condensable fraction in the exhaust (i.e., air). A refrigerant surface can be used allowing condensation to occur, or direct contact with a water spray can be used to reduce the temperature of the exhaust stream. A refrigerated heat exchange surface is not technically feasible for use with a biomass dryer since the condensable material can be sticky and would foul the surfaces. Although technically feasible, a direct contact condenser would not be efficient due to the large portion of lighter VOC in the air stream that would not be condensed since the exhaust temperature would not be able to be reduced low enough. Condensation was not considered as LAER for control of VOCs from the Rotary Dryer/Pulverized Wood Burner and Thermal Treatment Process.

Adsorption control consists of adsorbing VOCs onto a solid material, such as activated carbon or zeolites, having a large surface area. The absorbed material is then desorbed for reuse or is destroyed by thermal oxidation if reuse is not practical. The effectiveness of adsorption control can vary and is dependent on the concentration and moisture level in the exhaust stream. Semi-volatile organics have a high boiling point and are not readily desorbed. Moisture hampers the adsorption process. Due to the condensable organics and high moisture level in the Thermogen process stream, adsorption is not a technically feasible VOC control option.

Absorption is the use of a scrubber to transfer VOCs from the gas phase to a liquid stream, either reactively or passively. The reactant in the scrubber must be replenished or a portion of the VOC laden scrubber liquid media must be removed out and replaced with new liquid media. The use of absorption for VOC control is limited because few VOCs are reactive enough or have the properties suitable for absorption, such as low vapor pressure and high solubility in water. Due to the various organic constituents in the Thermogen process exhaust, there is not expected to be a high level of control using absorption. Although absorption was not considered as LAER for control of VOCs from the Rotary Dryer/Pulverized Wood Burner and Thermal Treatment Process, some incidental absorption of highly soluble VOC such as formaldehyde and methanol is expected to occur in the pre-quench step prior to the WESP.

Thermal oxidizers control VOCs by combusting the exhaust gas at high temperatures, destroying both volatile and semi-volatile (i.e. condensable) organic compounds. As described previously, regenerative thermal oxidizers utilize heat recovered from the incineration exhaust gases to preheat the inlet emission stream, which then passes through the preheated beds packed with ceramic media and gets further heated with a gas burner in a combustion chamber at 1450˚F-1600˚F with sufficient residence time to complete combustion. The combustion gases pass through a cooled ceramic bed transferring heat to the bed which preheats the gases to be treated when the flow through the beds are reversed. Thermogen has determined that an RTO is a feasible control option for the proposed facility and has been selected as part of the LAER strategy for control of VOCs.

Wet electrostatic precipitators (WESP) include a pre-quench to cool and saturate the gases which then enter the WESP, become charged, and are collected on oppositely charged plates. Some degree of VOC control is achieved by removing the condensable organics, although the non-condensable vaporous portions of the gas stream are not collected. The pre-quench step is expected to absorb some soluble VOCs, including methanol and formaldehyde. Thermogen has determined that a WESP is a feasible control option and has been selected as part of the LAER strategy for control of VOCs.

The following summarizes the VOC control technology rankings:

Rotary Dryer/Pulverized Wood Burner and Thermal Treatment Process VOC Control Technology Rankings

Control Technology	% VOC Control	Technical Feasibility
Condensation	Variable	Feasible
Adsorption	Variable	Infeasible
Absorption	Variable	Feasible
Regenerative Thermal Oxidizer ***SELECTED***	97	Feasible
Wet Electrostatic Precipitator ***SELECTED***	Variable	Feasible

LAER for VOC emissions from the Rotary Dryer/Pulverized Wood Burner and Steam Thermal Treatment Process, along with the pellet mill aspiration air routed to the burner, is the use of a WESP and RTO and the following emission limit:

VOC LAER Emission Limit –
Rotary Dryer/Pulverized Wood Burner and Thermal Treatment Process

Pollutant	Stack #1 (post WESP and RTO)
VOC	17.56 lb/hr*

* based on sum of: Rotary Dryer/Pulverized Wood Burner = 1.68 lb/hr
Thermal Treatment Process = 13.35 lb/hr
Pellet Aspiration Air = 2.53 lb/hr

Thermogen is required to offset the VOC emissions as described in section II(K) of this air emission license.

f. Opacity

Visible emissions from Stack #1 shall not exceed 20% opacity on a 6-minute block average, except for no more than one 6-minute block average in a 1-hour period of not more than 40% opacity per 06-096 CMR 115, BACT.

g. HAPs

HAP emissions are subject to a case-by-case MACT determination. The primary sources of HAP emissions from the facility are the Rotary Dryer, The Thermal Treatment Process, and the Pellet Mill Aspiration System. HAPs are present in filterable particulate matter, the condensable organic phase, and in the gas phase. The process at Thermogen has some similarities to conventional wood pellet and oriented strand board production, with a difference of the need to remove additional low molecular weight volatiles, including HAPs, whose weight does not proportionately contribute to the heating value of the final pellet product.

The top HAP control option for oriented strand board streams and other similar forest products industry exhaust streams is a combination of a WESP and RTO. This combination removes condensable and gas phase HAPs in the WESP pre-quench, condensable and filterable HAPs in the WESP itself, and condensable and gas phase HAPs in the RTO.

The following two tables summarize the calculated facility HAP emissions.

Calculated HAP Emissions from Individual Equipment in Tons/Year (Uncontrolled and Controlled)

HAP	Rotary Dryer/burner		Thermal Treatment System		Pellet Aspirator		Pellet Coolers		Steam Boiler
	UER	CER	UER	CER	UER	CER	UER	CER	UER
Acetaldehyde	4.31	0.13	363.1	10.35	-	-	-	-	-
Acrolein	8.28	0.25	-	-	-	-	-	-	-
Formaldehyde	9.63	0.39	3.1	0.08	-	-	-	-	0.01
Methanol	0.73	0.02	501.5	14.29	6.3	0.18	0.22	0.01	-
Hydrogen Chloride	0.41	0.41	-	-	-	-	-	-	-
Other HAPs (total)	6.867	0.293	-	-	-	-	-	-	0.32

Table Notes -

- UER = Estimated Uncontrolled Emission Rate in tons per year.
- CER = Controlled Emission Rate in tons per year.
- Based on 97% control for organic compounds.
- Calculations for the Thermal Treatment System were based on information from tests performed November 12, 2013 at the Zilkha Biomass Crocket, Texas plant.
- The specific HAPs grouped under other HAPs (total) can be found listed out individually in the application.
- The Emergency Generator was not included in the table since total HAPs were 4.88E-4 tpy.

Calculated HAPs Emissions Facility-Wide in Tons/Year (Uncontrolled and Controlled)

HAP	Facility-Wide	
	Estimated Uncontrolled Emission Rate	Controlled Emission Rate
Acetaldehyde	367.4	10.48
Acrolein	8.28	0.25
Formaldehyde	12.74	0.48
Methanol	508.75	14.5
Hydrogen Chloride	0.41	0.41
Other HAPs (total)	7.19	0.61

The case-by-case MACT determination for HAPs from the Thermogen process is the use of a WESP and RTO as an integrated pollution control system. By controlling and establishing emission limits for VOC, as well as PM and CO, the

HAP emissions from the facility will be reduced. The monitoring requirements for the Rotary Dryer, the WESP, and the RTO are similar to monitoring requirements established by EPA for other MACT standards.

h. Additional BACT/LAER/MACT Requirements, including monitoring and recordkeeping

The use of propane or CNG in the suspension burner may be used at startup and stabilization periods and shall be included in the fuel heat input capacity limit.

The Rotary Dryer shall not exceed a processing rate of 458,000 oven dried tons per year of material processed through the dryer on a 12-month rolling total, as dryer output (calculated from dryer input metering and moisture content). Records shall be maintained on a monthly and 12-month rolling total basis.

A temperature monitoring system shall be installed, operated, maintained, and calibrated on the Rotary Dryer in accordance with the manufacturer's recommendation.

The Rotary Dryer and Pulverized Wood Burner shall exit the associated process cyclones and exhaust through the WESP followed by the RTO for control prior to release to the atmosphere via stack #1, except for the portion of the exhaust that is re-circulated back into the Rotary Dryer from the process cyclones.

Exhaust from the Thermal Treatment Pressure Vessels shall exit through the Blow Tank and associated cyclones and shall also be routed through the WESP followed by the RTO for control prior to release to the atmosphere via stack #1.

Thermogen shall demonstrate proper WESP operation by monitoring appropriate parameters, proposed to include secondary voltage, quench inlet temperature, and WESP outlet temperature.

Thermogen shall demonstrate proper RTO operation with a temperature monitoring system to insure the control equipment is minimizing emissions.

The natural gas fired in the RTO and Steam Boiler combined shall be limited to 380 million standard cubic feet per year (MMscf/yr), equivalent to 387,805 MMBtu/yr at 1020 Btu/scf. This is representative of each piece of equipment operating 8322 hrs/year:
[(4 MMBtu/hr RTO x 8322 hrs/yr)+(42.6 MMBtu/hr Boiler x 8322 hrs/yr) = 387,805 MMBtu/yr].

Compliance with the natural gas fuel limit shall be determined by an installed fuel meter. Fuel records shall be maintained on a monthly and 12-month rolling total basis.

Within 180 days of commencing operation, Thermogen shall perform stack testing on Stack #1 for PM, PM_{10}, $PM_{2.5}$, NO_X, CO and VOC to determine compliance with the licensed emission limits.

Within 90 days of performing the required stack testing, Thermogen shall submit the following to the Department:

- Documentation of Rotary Dryer operating temperature parameter values and monitor details, including the frequency of collected data points and recordkeeping. The operating temperature parameters shall ensure proper operating conditions of the dryer.
- A plan detailing emissions control equipment operating and maintenance procedures and parameters, including applicable compliance indicators and values/ranges, monitoring approach and frequency, quality assurance practices and criteria, recordkeeping methods and inspections and testing to the Department for approval for the following:
  - the dryer FGR system, including fuel feed rate, combustion chamber oxygen concentration and FGR damper position;
  - the RTO, including minimum combustion chamber operating temperature; and
  - the WESP, proposed to include secondary voltage, quench inlet temperature, quench water flow rate and/or pressure, and WESP outlet temperature.

After the Department's review of the submitted plans and documentation, Thermogen shall submit a license application to incorporate the specifics of the dryer's operating temperature parameters and the RTO and WESP parameter requirements into the license.

A startup, shutdown, and malfunction plan detailing emissions, procedures, and timeframes for these events shall be included with the submittal of the Part 70 license application, required within 12 months of commencing operation.

2. Federal Regulations

   a. New Source Performance Standards: 40 CFR Part 60, Subpart Dc

   40 CFR Part 60, Subpart Dc, *Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units*, is applicable to steam generating units greater than or equal to 10 MMBtu/hr and less than or equal to 100 MMBtu/hr for which construction, modification, or reconstruction occurred after June 9, 1989. Steam generating unit is defined in 40 CFR Part 60, Subpart Dc as "a device that combusts any fuel and produces steam or heats water or heats any heat transfer medium. This term includes any duct burner that combusts fuel and is part of a combined cycle system. This term does not include process heaters as defined in this subpart." The Rotary Dryer's Pulverized Wood Burner

is not a steam-generating unit; therefore, 40 CFR Part 60, Subpart Dc is not applicable to the dryer burner.

b. National Emission Standards for Hazardous Air Pollutants

i. 40 CFR Part 63, Subpart DDDDD

40 CFR Part 63, Subpart DDDDD, *National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters*, is applicable to boilers at a facility classified as a major source of hazardous air pollutants. Thermogen is a major source for HAPs. 40 CFR Part 63, Subpart DDDDD defines boiler to mean "an enclosed device using controlled flame combustion and having the primary purpose of recovering thermal energy in the form of steam or hot water." A process heater is defined as "an enclosed device using controlled flame, and the unit's primary purpose is to transfer heat indirectly to a process material (liquid, gas, or solid) or to a heat transfer material (e.g. glycol or a mixture of glycol and water) for use in a process unit, instead of generating steam. Process heaters are devices in which the combustion gases do not come into direct contact with process materials." The Rotary Dryer's Pulverized Wood Burner is not considered a boiler since it does not generate steam and it is not a process heater because there is direct contact with the burner exhaust and the process material. 40 CFR Part 63, Subpart DDDDD is not applicable to the Rotary Dryer and Pulverized Wood Burner.

ii. 40 CFR Part 63, Subpart B

40 CFR Part 63, Subpart B, *Requirements for Control Technology Determinations for Major Sources in Accordance with Clean Air Act Sections 112(G) and 112(J)* is applicable to Thermogen since the facility is a major source of hazardous air pollutants and is not addressed explicitly as a source category in a specific Subpart. A case-by-case Maximum Achievable Control Technology (MACT) determination has been made for HAP emissions control consisting of the WESP and RTO.

D. <u>Steam Boiler</u>

Thermogen is proposing to install a 42.6 MMBtu/hr natural gas fired boiler to provide steam for the six thermal treatment pressure vessels in the Thermal Treatment Process. Compressed natural gas will be delivered by truck to the facility for use in the Steam Boiler. Emissions from the Steam Boiler have been proposed to be minimized by a low NO_X burner and flue gas recirculation prior to exiting Stack #2 at 79 feet above ground level.

1. BACT/LAER Findings

Thermogen submitted a BACT analysis addressing emissions and controls for PM, PM_{10}, $PM_{2.5}$, NO_X, SO_2, CO, and GHGs; and a LAER analysis for VOCs from the steam boiler. The following table contains the results of a review of the New Jersey State of the Art (SOTA) Manual, the Massachusetts BACT Guidance, and the South Coast Air Quality Management District (SCAQMD) in California, as these are considered to be stringent BACT standards:

Summary of Steam Boiler BACT/LAER Review

Rule or Guidance	Technology	Emission Limits				
		PM_{10}	NO_X	SO_2	CO	VOC
Massachusetts 'top case' BACT for boilers < 40 MMBtu/hr	Low NO_X burners and FGR	0.01 lb/MMBtu	0.035 lb/MMBtu	N/A	0.08 lb/MMBtu	0.03 lb/MMBtu
Massachusetts 'top case' BACT for boilers > 40 MMBtu/hr and < 100 MMBtu/hr	Ultra-low NO_X burners	0.002 lb/MMBtu	0.011 lb/MMBtu (9ppmvd)	N/A	0.035 lb/MMBtu	0.035 lb/MMBtu
NJ SOTA for boilers 10-50 MMBtu/hr	Low NO_X burners and FGR or ultra-low NO_X burners	-	0.035 lb/MMBtu	-	0.05 lb/MMBtu	0.005 lb/MMBtu
SCAQMD boilers >20 MMBtu/nr	Not specified	Natural gas firing	9 ppmvd@3%O_2 7ppmvd if add-on controls used	-	100 ppmvd@3%O_2 for watertube boilers 50 ppmvd@3% O_2 for firetube boilers	-

The BACT emission limits for the Steam Boiler were based on the following:

a. $PM/PM_{10}/PM_{2.5}$

Particulate matter emissions from combustion in industrial boilers vary dependent on the fuel fired. Natural gas fired units emit very low amounts of PM due to the fuel constituents, provided the air and fuel are mixed properly and the combustion equipment is maintained as recommended by the manufacture. Since natural gas is an inherently clean burning fuel, no add on controls or additional control options were reviewed to further minimize PM emissions.

BACT for $PM/PM_{10}/PM_{2.5}$ emissions from the Steam Boiler is the firing of natural gas, in addition to good combustion and operating practices. The BACT particulate matter emissions limits are the following, based on 0.007 lb/MMBtu:

$PM/PM_{10}/PM_{2.5}$ BACT Emission Limits - Steam Boiler

Pollutant	Stack #2
PM (filterable)	0.3 lb/hr
PM_{10} (total: filterable and condensable)	0.3 lb/hr
$PM_{2.5}$ (total: filterable and condensable)	0.3 lb/hr

b. SO_2

Sulfur in the fuel results in SO_2 emissions from combustion. Natural gas produces inherently low emissions when fired since there is negligible sulfur content.

BACT for SO_2 emissions from the Steam Boiler is the firing of natural gas and the following emission limit, based on 0.0006 lb/MMBtu:

SO_2 BACT Emission Limit – Steam Boiler

Pollutant	Stack #2
SO_2	0.026 lb/hr

c. NO_X

Natural gas fired boilers generate NO_X through three mechanisms: fuel NO_X through oxidation of nitrogen in the fuel; thermal NO_X from nitrogen and oxygen reactions at high temperature; and prompt NO_X from N_2 reacting rapidly with hydrocarbon radicals. Add-on NO_X control options reviewed for the Steam Boiler include Selective Catalytic Reduction (SCR) and combustion control options, including low NO_X burners, flue gas recirculation, and clean fuels.

SCR utilizes urea or ammonia as a reducing agent followed by a catalyst to promote NO_X to molecular nitrogen. SCR systems are rarely used on boilers of the proposed size (42.6 MMBtu/hr). Based on the storage and delivery requirements for the reducing agent, the use of a catalyst, and system equipment and maintenance, SCR was not considered a feasible control option for this size boiler due to complexity and cost.

Combustion control options can reduce thermal NO_X by reducing peak flame temperature using specific burner designs and/or flue gas recirculation. Staged combustion is also utilized to control excess air. Low NO_X burners are available that incorporate these combustion control methods, obtaining 30 ppmvd @ 3% oxygen. In addition, there are ultra-low NO_X burners that can achieve even lower NO_X, possibly reducing prompt NO_X as well as thermal NO_X. These ultra-low NO_X burners require complex controls, cost substantially more than low NO_X

burners, are more prone to condensation of moisture in the flue gas in cold weather conditions due to the high rate of gas recirculation, and require longer periods to adjust to load variations. Due to the batch nature of the Thermal Treatment Process, the steam loads may swing rapidly over short periods of time due to pairs of thermal treatment reactors being steam pressurized then flash depressurized. Although the overall facility will be operated as a continuous process because the reactors can be sequenced, the reactors themselves will require steam in batches. Based on these possible rapid steam load swings, the ultra-low NO_X burners are considered technically infeasible, but a low NO_X burner with flue gas recirculation is a feasible option.

Fuel NO_X will be minimized by combusting only natural gas, which is a low nitrogen fuel.

BACT for NO_X emissions from the Steam Boiler is the use of a low NO_X burner in conjunction with FGR, the firing of only natural gas, and the following emission limit, based on 0.036 lb/MMBtu:

NO_X BACT Emission Limits - Steam Boiler

Pollutant	Stack #2
NO_X	1.53 lb/hr

d. CO

CO emissions result from incomplete combustion. Previously, lower NO_X formation resulted in higher CO emissions because of lower targeted flame temperatures and fuel rich combustion zones. However, low NO_X burners with staged firing and flue gas recirculation can now achieve CO levels of 50 ppmdv at 3% O_2 when firing natural gas. This emission level is similar or better than other boilers of the same size and fuel type.

BACT for CO emissions from the Steam Boiler is the use of a low NO_X burner with FGR and the following emission limit, based on 0.0365 lb/MMBtu:

CO BACT Emission Limits - Steam Boiler

Pollutant	Stack #2
CO	1.55 lb/hr

e. VOC

VOC emissions from industrial boilers of the size and type proposed by Thermogen are typically controlled by managing combustion conditions. Massachusetts BACT guidance for boilers between 40 and 100 MMBtu/hr is 0.035 lb/MMBtu. Recent permits issued in Rhode Island for boilers greater than 10 MMBtu/hr have ranged from 0.004 to 0.006 lb/MMBtu.

LAER for VOC emissions from the Steam Boiler is good combustion practices and the following emission limit, based on 0.005 lb/MMBtu:

VOC LEAR Emission Limit - Steam Boiler

Pollutant	Stack #2
VOC	0.21 lb/hr

f. Opacity

Visible emissions from Stack #2 shall not exceed 10% opacity on a 6-minute block average basis, per 06-096 CMR 115, BACT.

g. Additional BACT/LAER Requirements, including monitoring/recordkeeping

The natural gas fired in the Steam Boiler and RTO combined shall be limited to 380 MMscf/yr, equivalent to 387,805 MMBtu/yr at 1020 Btu/scf (each unit operating 8322 hrs/year), based on a 12-month rolling total. Compliance shall be determined by an installed fuel meter. Fuel records shall be maintained on a monthly and 12-month rolling total basis.

Emissions from the Steam Boiler shall be minimized through the proper use and maintenance of a low NO_X burner and flue gas recirculation.

2. Federal Regulations

a. New Source Performance Standards: 40 CFR Part 60, Subpart Dc

40 CFR Part 60, Subpart Dc is applicable to the Steam Boiler, since it is a steam generating unit greater than or equal to 10 MMBtu/hr and less than or equal to 100 MMBtu/hr for which construction, modification, or reconstruction occurred after June 9, 1989. There are no specific emission limits included in 40 CFR Part 60, Subpart Dc for gas-fired boilers; however, Thermogen shall comply with the applicable notification, recordkeeping, and reporting requirements in the rule.

b. National Emission Standards for Hazardous Air Pollutants: 40 CFR Part 63 Subpart DDDDD

40 CFR Part 63, Subpart DDDDD is applicable to the Steam Boiler. The Steam Boiler is not subject to numerical emission limits or fuel testing requirements since only natural gas will be combusted. The unit is subject to applicable work practice requirements (periodic tune-ups) and notification, reporting, and recordkeeping requirements.

E. Pellet Mills and Pellet Coolers

From the Thermal Treatment Process blow tank, the thermally treated dry chips will be ground and sent to the Pellet Mills. The six Pellet Mills will shape the chips into pellets via high heat extrusion. From the Pellet Mills, the pellets will be screened then sent to the Pellet Coolers. The two Pellet Coolers will be used to reduce the temperature of the pellets via air cooling prior to storage or shipping.

Aspiration air of approximately 2500 cubic feet per minute (CFM) from each Pellet Mill will be directed through a fabric filter and will then continue to the dryer burner for use as combustion air. This aspiration air will be controlled as part of the dryer emissions without increasing the overall air flow through the main pollution control system. The fines collected will be returned to the Pellet Mill. There is no direct atmospheric exhaust from the fabric filter for the Pellet Mill aspiration air.

Each Pellet Cooler's flow of 30,000 CFM will be directed though high efficiency cyclones before being exhausted to atmosphere.

Thermogen has proposed a final product production limit to ensure compliance with the proposed limits in the license.

The BACT/LAER findings for the Pellet Mills and Pellet Coolers are summarized below:

a. $PM/PM_{10}/PM_{2.5}$
   i. Pellet Mills
   Particulate matter emissions from the Pellet Mill extrusion shaping process will be entrained in the aspiration air. This air will be routed through a fabric filter, through the Pulverized Wood Burner, and through the WESP and RTO. The particulate matter emissions will be controlled by these three pieces of add-on control equipment, as well as through dryer burner combustion. The proposed control for the aspiration air represents BACT for particulate emissions from the Pellet Mills. The BACT emission limit from the Pellet Mills is included in the stack #1 emission limits for PM of 3.85 lb/hr, PM_{10} of 3.85 lb/hr, and $PM_{2.5}$ of 3.85 lb/hr.

ii. Pellet Coolers

The Pellet Cooler particulate matter is a small portion of the emissions from the pelletizing process. The majority of the PM will be controlled through the Pellet Mill exhaust as described above. Thermogen reviewed the use of the process cyclones followed by fabric filters as a control option for the Pellet Coolers. The total exhaust flow rate of 60,000 scfm for both coolers is relatively high compared to the total estimated emission rate of 5.5 lb/hr from the two process cyclones. A mid-range cost estimate for a Pulse-Jet type fabric filter for the Pellet Coolers resulted in a $960,000 capital cost and a $1,350,000 annualized cost, with an estimated control cost of $56,000/ton. Thermogen determined that use of fabric filters in addition to the cyclones would not be cost effective.

BACT for particulate control for the Pellet Coolers is the use of high efficient cyclones with approximately 95% removal efficiency, with the following particulate limits:

$PM/PM_{10}/PM_{2.5}$ BACT Emission Limits – Pellet Coolers

Pollutant	Pellet Coolers 1 and 2 (from each cyclone)
PM (filterable)	2.75 lb/hr
PM_{10} (total: filterable and condensable)	0.275 lb/hr
$PM_{2.5}$ (total: filterable and condensable)	0.137 lb/hr

Visible emissions from each of the Pellet Cooler cyclones shall not exceed 20% opacity on a 6-minute block average basis, except for no more than one 6-minute block average in a 1-hour period of not more than 40% opacity, per 06-096 CMR 101 and 06-960 CMR 115, BACT.

b. VOC

i. Pellet Mills

Volatile organic compounds will be present in the aspiration air routed from the Pellet Mills to the Rotary Dryer. The VOC emissions will be controlled by the WESP and RTO, as well as by combustion in the dryer burner. The proposed control for the aspiration air represents LAER for VOC emissions from the Pellet Mills. A review of pellet mills found very few VOC controls on the pelletizing process at other facilities. The LAER emission limit from the Pellet Mills is included in the Stack #1 VOC emission limit of 17.56 lb/hr.

ii. Pellet Coolers

The Pellet Coolers are estimated to have a total air flow of approximately 60,000 scfm with a concentration of VOC of approximately 7 ppm, as propane. This is in the range of guaranteed VOC outlet concentrations provided by manufacturers of thermal oxidation equipment (5-10 ppm, as propane). Routing this low VOC concentration and high flow rate exhaust stream through a VOC control system would not be expected to substantially reduce facility VOC emissions, since the estimated VOCs are less than 0.5% of the total VOC emitted from the processes at the facility.

LAER for VOC emissions from the Pellet Coolers is the following limit:

VOC LAER Emission Limit – Pellet Coolers

Pollutant	Pellet Coolers 1 and 2 (each)
VOC	1.33 lb/hr

c. Additional BACT/LAER Requirements, including monitoring/recordkeeping

The aspiration air from the Pellet Mills shall be routed through a fabric filter to the dryer burner. The fabric filter for the Pellet Mills aspiration air shall be properly maintained and pressure drop shall be monitored minimally once per shift. Compliance records shall be kept documenting routine and unplanned maintenance on the fabric filter, including dates, times, and tasks performed.

The exhaust from the Pellet Coolers shall be routed to high efficiency cyclones prior to being released to the atmosphere. The cyclones for the Pellet Coolers shall be properly maintained and shall also be inspected visually once per day (24 hour period). Compliance records shall be kept documenting visual inspections and routine and unplanned maintenance on the cyclones, including dates, times, and tasks performed.

Thermogen shall not exceed a final product production rate of 387,805 ODT/yr of pellets based on a 12-month rolling total, as measured at the rail car loading operations. Production records shall be maintained on a monthly and 12-month rolling total basis.

Within 180 days of commencing operation, Thermogen shall perform stack testing on one stack of the Pellet Cooler for VOC to determine compliance with the licensed emission limit.

F. Fuel Hammermill Aspiration, Dry Chips Pneumatic Transfer System, and Pellet System Fines Transfer

The Thermogen process includes three additional specific exhaust points with the potential to release particulate matter not covered by the previous sections. These points are the Fuel Hammermill Aspiration, the Dry Chips Pneumatic Transfer System, and the

Pellet System Fines Transfer. The Fuel Hammermill Aspiration is the exhaust air cyclonically separated from the fuel dust once the dry chips go through the Hammermill. The exhaust from the Dry Chips Pneumatic Transfer System consists of air cyclonically separated during conveyance of chips from the dry chip silo to the Thermal Treatment Process. The exhaust from the Pellet System Fines Transfer consists of air cyclonically separated during the recirculation of pellet fines from the pellet screen back into the Pellet Mill.

Thermogen has proposed to use fabric filters to control particulate from these three transfer sources, since fabric filters are recognized as one of the most effective particulate matter control systems for these types of processes.

BACT for particulate matter control from transfer areas shall be the use of fabric filters on each of the following: the Fuel Hammermill Aspiration, the Dry Chips Pneumatic Transfer system, and the Pellet System Fines Transfer. Visible emissions from each of the fabric filters shall not exceed 10% opacity on a 6-minute average basis, except for no more than one 6-minute block average in a 1-hour period of not more than 40% opacity. The facility shall take corrective action if visible emissions from the fabric filters exceed 5% opacity. The opacity limit is based on 06-096 CMR 101 for baghouses and 06-096 CMR 115, BACT.

The fabric filters shall be properly maintained and pressure drop shall be monitored and recorded minimally once per shift. Compliance records shall be kept documenting routine and unplanned maintenance on the fabric filter, including dates, times, and tasks performed.

G. Fugitive Emissions

Fugitive emissions may result from the transfer of raw material (wet chips), the transfer of finished product (pellets), stockpiles on site, and roadways.

The raw wood chips delivered to the woodyard are expected to have 45% moisture content, resulting in minimal fugitive emissions from raw material storage and handling. Covered conveyors and covered loading stations shall be BACT for the transfer of raw material and finished product.

Visible emissions from a fugitive emission source (including stockpiles and roadways) shall not exceed an opacity of 20%, except for no more than five (5) minutes in any 1-hour period. Compliance shall be determined by an aggregate of the individual fifteen (15)-second opacity observations which exceed 20% in any one (1) hour. The opacity limit is based on 06-096 CMR 101 for fugitive emissions sources. This requirement is not being revised from the previous license.

H. General Process

Visible emissions from any general process source not specifically addressed shall not exceed an opacity of 20% on a six (6) minute block average basis, except for no more than one (1) six (6) minute block average in a 1-hour period, based on 06-096 CMR 101. This requirement is not being replaced or revised from the previous license.

I. Emergency Generator

The proposed Emergency Generator is rated at 2.68 MMBtu/hr heat input (250 kW, 382 hp output rating) and shall fire distillate fuel with a maximum sulfur content of 0.0015%. The Emergency Generator will be a new unit and will be limited to annual operations of 100 hours/year, not including emergency use.

1. BACT Findings

The BACT emission limits for the generator are based on the following:

$PM/PM_{10}/PM_{2.5}$	- 0.17 g/bhp-hr, manufacturers data for Caterpillar 250DQDAA generator; more stringent than 06-096 CMR 103
SO_2	- combustion of distillate fuel with a maximum sulfur content not to exceed 15 ppm (0.0015% sulfur by weight)
NO_x	- 3.42 g/bhp-hr, manufacturers data for Caterpillar 250DQDAA generator
CO	- 2.60 g/bhp-hr, manufacturers data for Caterpillar 250DQDAA generator
VOC	- 0.05 g/bhp-hr, manufacturers data for Caterpillar 250DQDAA generator
Opacity	- 06-096 CMR 101 and 006-096 CMR 115, BACT

The BACT emission limits for the generator are the following:

Unit	PM (lb/hr)	PM_{10} (lb/hr)	$PM_{2.5}$ (lb/hr)	SO_2 (lb/hr)	NO_x (lb/hr)	CO (lb/hr)	VOC (lb/hr)
Emergency Generator (2.68 MMBtu/hr, distillate fuel)	0.14	0.14	0.14	0.004	2.88	2.19	0.04

Visible emissions from the Emergency Generator shall not exceed 20% opacity on a 6-minute block average, except for no more than two 6- minute block averages in a 3-hour period of not more than 40% opacity.

2. 40 CFR Part 60, Subpart IIII

The federal regulation 40 CFR Part 60, Subpart IIII, *Standards of Performance for Stationary Compression Ignition Internal Combustion Engines (CI ICE)* is applicable to the emergency generator listed above since the unit will be ordered after July 11, 2005 and manufactured after April 1, 2006. By meeting the requirements of Subpart IIII, the units also meet the requirements found in the *National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines*, 40 CFR Part 63, Subpart ZZZZ.

a. Emergency Definition:
Emergency stationary ICE means any stationary reciprocating internal combustion engine that meets all of the following criteria:

(1) The stationary ICE is operated to provide electrical power or mechanical work during an emergency situation. Examples include stationary ICE used to produce power for critical networks or equipment (including power supplied to portions of a facility) when electric power from the local utility (or the normal power source, if the facility runs on its own power production) is interrupted, or stationary ICE used to pump water in the case of fire or flood, etc. There is no time limit on the use of emergency stationary ICE in emergency situations.

(2) Paragraph (1) above notwithstanding, the emergency stationary ICE may be operated for any combination of the purposes specified below for a maximum of 100 hours per calendar year:

(i) Maintenance checks and readiness testing, provided that the tests are recommended by federal, state or local government, the manufacturer, the vendor, the regional transmission organization or equivalent balancing authority and transmission operator, or the insurance company associated with the engine. The owner or operator may petition the Administrator for approval of additional hours to be used for maintenance checks and readiness testing, but a petition is not required if the owner or operator maintains records indicating that federal, state, or local standards require maintenance and testing of emergency ICE beyond 100 hours per calendar year.
(ii) Emergency demand response for periods in which the Reliability Coordinator under the North American Electric Reliability Corporation (NERC) Reliability Standard EOP-002-3, Capacity and Energy Emergencies (incorporated by reference, see §63.14), or other authorized entity as determined by the Reliability Coordinator, has declared an Energy Emergency Alert Level 2 as defined in the NERC Reliability Standard EOP-002-3.
(iii) Periods where there is a deviation of voltage or frequency of 5 percent or greater below standard voltage or frequency.

(3) Paragraphs (1) and (2) above notwithstanding, emergency stationary ICE may be operated for up to 50 hours per calendar year in non-emergency situations.

These 50 hours are counted as part of the 100 hours per calendar year for maintenance checks and readiness testing, emergency demand response, and periods of voltage deviation or low frequency, as provided in paragraph (2) above.

The 50 hours per calendar year for non-emergency situations cannot be used for peak shaving, non-emergency demand response, or to generate income for a facility by providing power to an electric grid or otherwise supply power as part of a financial arrangement with another entity, except if the following conditions are met:

(i) The engine is dispatched by the local balancing authority or local transmission and distribution system operator.
(ii) The dispatch is intended to mitigate local transmission and/or distribution limitations so as to avert potential voltage collapse or line overloads that could lead to the interruption of power supply in a local area or region.
(iii) The dispatch follows reliability, emergency operation or similar protocols that follow specific NERC, regional, state, public utility commission or local standards or guidelines.
(iv) The power is provided only to the facility itself or to support the local transmission and distribution system.
(v) The owner or operator identifies and records the entity that dispatches the engine and the specific NERC, regional, state, public utility commission or local standards or guidelines that are being followed for dispatching the engine. The local balancing authority or local transmission and distribution system operator may keep these records on behalf of the engine owner or operator.

[40 CFR §60.4211(f) and §60.4219]

b. 40 CFR Part 60, Subpart IIII Requirements:

(1) Manufacturer Certification Requirement
The generator shall be certified by the manufacturer as meeting the emission standards for new nonroad compression ignition engines found in 40 CFR §60.4202. [40 CFR §60.4205(b)]

(2) Ultra-Low Sulfur Fuel Requirement
The fuel fired in the generator shall not exceed 15 ppm sulfur (0.0015% sulfur), except that any existing fuel purchased (or otherwise obtained) prior to October 1, 2010, may be used until depleted. [40 CFR §60.4207(b)]

(3) Non-Resettable Hour Meter Requirement
A non-resettable hour meter shall be installed and operated on the generator. [40 CFR §60.4209(a)]

(4) Operation and Maintenance Requirements
The generator shall be operated and maintained according to the manufacturer's emission-related written instructions or procedures developed by facility that are approved by the engine manufacturer. Thermogen may only change those emission-related settings that are permitted by the manufacturer. [40 CFR §60.4211(a)]

(5) Annual Time Limit for Maintenance and Testing
The generator shall be limited to 100 hours/year for maintenance checks and readiness testing, emergency demand response, and periods of voltage or frequency deviation from standards. Up to 50 hours/year of the 100 hours/year may be used in non-emergency situations (this does not include peak shaving, non-emergency demand response, or to generate income for a facility by providing power to an electric grid or otherwise supply power as part of a financial arrangement with another entity unless the conditions in §60.4211(f)(3)(i) are met). [40 CFR §60.4211(f)]

(6) Initial Notification Requirement
No initial notification is required for emergency engines. [40 CFR §60.4214(b)]

(7) Recordkeeping
Thermogen shall keep records that include maintenance conducted on the engine(s) and the hours of operation of the engine recorded through the non-resettable hour meter. Documentation shall include the hours spent for emergency operation, including what classified the operation as emergency and how many hours spent for non-emergency. If the generator is operated during a period of demand response or deviation from standard voltage or frequency, or to supply power during a non-emergency situation as part of a financial arrangement with another entity as specified in §60.4211(f)(3)(i), Thermogen shall keep records of the notification of the emergency situation, and the date, start time, and end time of generator operation for these purposes. [40 CFR §60.4214(b)]

(8) Annual Reporting Requirements for Demand Response Availability Over 15 Hours Per Year (for generators greater than 100 brake hp)
If Themogen operates or is contractually obligated to be available for more than 15 hours per calendar year in a demand response program, during a period of deviation from standard voltage or frequency, or supplying power during a non-emergency situation as part of a financial arrangement with another entity as specified in §60.4211(f)(3)(i), the facility shall submit an annual report containing the information in §60.4214(d)(1)(i) through (vii). The first annual report must cover the calendar year 2015 and must be submitted no later than March 31, 2016. Subsequent annual reports for each calendar year must be submitted no later than March 31 of the following

calendar year. The annual report must be submitted electronically using the Compliance and Emissions Data Reporting Interface (CEDRI) that is accessed through EPA's Central Data Exchange (CDX) (www.epa.gov/cdx). However, if the reporting form is not available in CEDRI at the time that the report is due, the written report must be submitted to the following address:

U.S. Environmental Protection Agency, Region I
5 Post Office Square, Suite 100 (OES04-2)
Boston, MA 02109-3912
Attn: Air Compliance Clerk

[40 CFR §60.4214(d)]

J. Facility-Wide Greenhouse Gases (GHG)

The Pulverized Wood Burner is the primary source of GHGs, followed by the Steam Boiler, the RTO and the Emergency Generator. The GHGs from these combustion units consist primarily of carbon dioxide (CO_2) with small amounts of nitrous oxide (N_2O) and methane. Control options for GHG emissions were identified as carbon capture and storage, the use of alternative fuels, and energy efficiency.

Carbon capture and storage is a developing technology that has the potential to reduce CO_2 emissions from a high purity CO_2 stream. Carbon capture and storage consists of capturing CO_2 from large point sources, transporting it to a storage site, and depositing it in an underground geological formation to prevent release into the atmosphere. Where feasible, it is one of the most effective CO_2 emissions reduction options. The current utilization focus for the technology is to reduce CO_2 emissions from large utility coal fired boilers. At this time, carbon capture and storage is not technically feasible for biomass-fired dryers or natural gas-fired package boilers.

The alternative fuels option for reducing CO_2 emissions is based on the fact that various fuels emit different amounts of CO_2 when combusted. Biomass has a higher CO_2 emission rate on a heat input basis than fuel oil, propane, and natural gas. However, use of an alternative fuel in the Rotary Dryer's Pulverized Wood Burner could be considered to fundamentally redefine the proposed facility. Use of a portion of the dried wood chips as fuel in the Rotary Dryer's Pulverized Wood Burner is an inherent design criteria for this proposed project. The use of biomass as a fuel to manufacture the pellet product will be considered GHG neutral in countries seeking to reduce GHG emissions. The pellet product is considered a biomass replacement for coal as a renewable source. Using fossil fuels in the production of the pellets would lower the inherent value of the pellets as a coal replacement by increasing the life-cycle embedded carbon generated in the production of the pellets. Fossil fuel (i.e. natural gas) is used only where essential, such as in the RTO and in the Steam Boiler. A solid fuel in the Steam Boiler would not allow response to rapid load swings. Based on the facility's design criteria and GHG considerations by the consumer of the pellets, the use of alternative fuels in the Rotary

Dryer's Pulverized Wood Burner was not considered as a viable BACT option for the reduction of GHG emissions.

Energy efficiency is a technically feasible BACT control option for GHGs. The energy efficient measures incorporated in the proposed Thermogen project include the use of an RTO as a control device, recirculation of a portion of the dryer exhaust, and the use of the exhaust from the Pellet Mill aspiration system as combustion/make-up air for the Rotary Dryer's Pulverized Wood Burner. RTO's recover approximately 95% of the heat used to oxidize VOC and HAP, compared to 40-70% for a recuperative oxidizer. In addition, because of the large VOC loading, the RTO is self-sustaining once the combustion of VOCs produces enough heat to maintain the required operating temperature. The supplemental natural gas requirement is expected to be only approximately 4 MMBtu/hr. The overall fuel usage in the Rotary Dryer's Pulverized Wood Dryer will be reduced due to exhaust recirculation. By reusing the exhaust stream from the Pellet Mill Aspiration System in the Rotary Dryer's Pulverized Wood Burner operations, overall flow rate through the RTO is reduced, decreasing RTO fuel requirements.

Energy efficiency is also a feasible option for the control of GHGs from the Emergency Generator. Use of a tier-certified engine results in lower emissions due to lower mass emission rates and the design efficiencies established in newer engines.

BACT for GHG emissions from Thermogen shall be the use of natural gas for the Steam Boiler and RTO, and the use of the following energy efficiency measures: the use of an RTO as a control device, recirculation of a portion of the dryer exhaust, the use of the exhaust from the Pellet Mill aspiration system as combustion/make-up air for the Rotary Dryer's Pulverized Wood Burner, and the use of a tier-certified Emergency Generator.

K. Offsets

Major stationary sources that seek to locate within an area which is designated as nonattainment for ozone or in the Ozone Transport Region (OTR) must obtain offset credits as provided in *Growth Offset Regulation*, 06-096 CMR 113. This includes sources with emissions of a nonattainment pollutant above the significant levels after the application of LAER. For Thermogen, reduction credits must be obtained for VOCs since the facility's proposed licensed VOC emissions are above the 50 tons per year significant emission levels and the source is located within the OTR, consisting of the entire state of Maine. The offset credits must be permanent, enforceable, surplus, real and quantifiable reductions.

Thermogen must offset 85.02 tons/year of proposed VOC emissions. In air emission license A-1072-77-1-N, Thermogen was approved for the use of 205.05 tons/year of NO_X emissions to be used for VOC offsets from the permanent shutdown of the GNP West, Inc. Magnesium Oxide (MgO) Recovery Boiler. These certified credits will be used for the proposed project. License amendment A-406-77-4-O was issued on September 24, 2012 to GNP West, Inc. and Great Northern Paper Company, LLC to permanently retire the MgO Recovery Boiler and certify the generation of NO_X emission credits.

Using the established VOC offset ratio of 1.15 to 1 set forth in 06-096 CMR 113, Thermogen shall utilize 97.99 tons of the certified NO_X credits to offset the 85.02 tons of proposed VOC emissions, as approved previously.

L. Annual Emissions

1. Total Annual Emissions

Thermogen shall be restricted to the following annual emissions, based on a 12 month rolling total (or calendar year). The tons per year limits were calculated based on the use of a maximum processing rate of 458,000 oven dried tons per year of material processed through the dryer on a 12-month rolling total, the Steam Boiler and RTO fuel limit of 380 MMscf/year, a final product production rate of 387,805 ODT/yr of pellets on a 12-month rolling total, and 100 hours/year operation of the Emergency Generator:

Total Licensed Annual Emissions for the Facility
Tons/year
(used to calculate the annual license fee)

	PM	PM_{10}	$PM_{2.5}$	SO_2	NO_x	CO	VOC
Stack #1 (Rotary Dryer, Pulverized Wood Burner, RTO, Thermal Treatment Process, and Pellet Mill Aspiration System)	11.85	11.85	11.85	12.00	92.38	54.16	73.08
Steam Boiler	1.24	1.24	1.24	0.11	6.38	6.57	0.89
Pellet Coolers (2, total)	22.88	2.29	1.14	-	-	-	11.05
Emergency Generator	0.007	0.007	0.007	negl	0.14	0.11	0.002
Total TPY	**35.98**	**15.39**	**14.23**	**12.11**	**98.9**	**60.74**	**85.02**

Table Notes:

- PM_{10}, $PM_{2.5}$, and CO emissions are not included in the calculation of the annual license fee and are listed for informational purposes only.
- Although PM emissions were estimated from the Hammermill Aspiration (0.034 tons/year), the Dry Chips Pneumatic Transfer system (0.230 tons/year), and the Pellet System Fines Transfer (0.07 tons/year) to establish Thermogen's major or minor classification, they are not included in the table since compliance will be determined by opacity rather than a PM emission limit.

- The Steam Boiler and RTO tons/year numbers were based on operation of each for 8322 hrs/year. This is reflective in the 380 MMscf/year licensed fuel limit for both.

2. Greenhouse Gases

   Greenhouse gases are considered regulated pollutants as of January 2, 2011, through 'Tailoring' revisions made to EPA's *Approval and Promulgation of Implementation Plans,* 40 CFR Part 52, Subpart A, §52.21 Prevention of Significant Deterioration of Air Quality rule. Greenhouse gases, as defined in 06-096 CMR 100 (as amended), are the aggregate group of the following gases: Carbon dioxide, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. For licensing purposes, greenhouse gases (GHG) are calculated and reported as carbon dioxide equivalents (CO_2e).

   CO_2e is not used to calculate the annual fee and is not listed in the above table. The source is already classified as major for greenhouse gases and does not currently have annual restrictions imposed.

III. AMBIENT AIR QUALITY ANALYSIS

A. Overview

A refined modeling analysis was performed to show that emissions from Thermogen, in conjunction with other sources, will not cause or contribute to violations of National Ambient Air Quality Standards (NAAQS) for SO_2, PM_{10}, $PM_{2.5}$, NO_2 or CO or of Class II increments for SO_2, PM_{10}, $PM_{2.5}$ or NO_2.

Based upon the magnitude of proposed emissions increase and the distance from the source to any Class I area, the affected Federal Land Managers (FLMs) and MEDEP-BAQ have determined that an assessment of Class I Air Quality Related Values (AQRVs) is not required.

B. Model Inputs

The AERMOD-PRIME refined model was used to address standards and increments in all areas. If applicable, the modeling analysis accounted for the potential of building wake and cavity effects on emissions from all modeled stacks that are below their calculated formula GEP stack heights.

All modeling was performed in accordance with all applicable requirements of the Maine Department of Environmental Protection, Bureau of Air Quality (MEDEP-BAQ) and the United States Environmental Protection Agency (USEPA).

A valid five-year hourly on-site meteorological database was used in the AERMOD-PRIME refined modeling analysis. The following parameters and their associated heights were collected at the Great Northern Paper meteorological monitoring site during the 5-year period 1990-1993 and July 1, 1994 – June 30, 1995:

TABLE III-1: Meteorological Parameters and Collection Heights

Parameter	Sensor Height(s)
Wind Speed	10 meters, 90 meters
Wind Direction	10 meters, 90 meters
Standard Deviation of Wind Direction (Sigma A)	10 meters, 90 meters
Temperature	3 meters

Per USEPA guidance, any small gaps (two hours or less) of missing on-site data were filled in using linear interpolation. Larger gaps of missing data (three or more hours) were coded as missing.

In addition, hourly Bangor NWS data from the same time period were used to supplement the primary surface dataset for the required variables (cloud cover and ceiling height) that were not explicitly collected at the Great Northern Paper meteorological monitoring site. Concurrent upper-air data from the Caribou NWS site were also used in the analysis. Missing cloud cover and/or upper-air data values were interpolated or coded as missing, per USEPA guidance.

All necessary representative micrometeorological surface variables for inclusion into AERMET (surface roughness, Bowen ratio and albedo) were calculated using AERSURFACE from procedures recommended by USEPA.

Point-source parameters, used in the modeling for Thermogen are listed in Table III-2.

TABLE III-2: Point Source Stack Parameters

Facility/Stack	Stack Base Elevation (m)	Stack Height (m)	GEP Stack Height (m)	Stack Diameter (m)	UTM Easting NAD83 (m)	UTM Northing NAD83 (m)
CURRENT/PROPOSED						
Thermogen						
• RTO Stack	114.30	45.72	51.83	2.29	523,136	5054,704
• Boiler Stack	114.30	24.08	51.83	0.66	523,196	5054,718
• Hammermill Baghouse	114.30	24.08	51.83	0.71	523,121	5054,691
• Pneumatic Transfer System	114.30	30.18	51.83	0.51	523,206	5054,681
• Pellet Cooler #1	114.30	27.13	51.83	1.01	523,237	5054,651
• Pellet Cooler #2	114.30	27.13	51.83	1.01	523,241	5054,654
• Pellet System Fines	114.30	27.13	51.83	0.20	523,212	5054,686

Facility/Stack	Stack Base Elevation (m)	Stack Height (m)	GEP Stack Height (m)	Stack Diameter (m)	UTM Easting NAD83 (m)	UTM Northing NAD83 (m)
GNP Paper East						
• Boiler #1	93.10	51.51	76.60	2.74	533,141	5052,263
• Boiler #2	93.10	51.51	76.60	2.74	533,148	5052,276
• Boiler #3	93.10	82.00	76.60	2.59	533,126	5052,317

Emission parameters for NAAQS and increment modeling are listed in Table III-3.

For the purpose of determining NO_2 impacts, all NO_x emissions were conservatively assumed to convert to NO_2.

TABLE III-3: Stack Emission Parameters

Facility/Stack	Averaging Periods	SO_2 (g/s)	PM_{10} (g/s)	$PM_{2.5}$ (g/s)	NO_2 (g/s)	CO (g/s)	Stack Temp (K)	Stack Velocity (m/s)
MAXIMUM LICENSE ALLOWED								
Thermogen								
• RTO Stack	All	0.504	0.485	0.485	3.871	2.274	384.26	21.07
• Boiler Stack	All	0.003	0.038	0.038	0.193	0.196	505.37	18.13
• Hammermill Baghouse	All	-	0.004	0.004	-	-	310.93	17.31
• Pneumatic Transfer System	All	-	0.029	0.029	-	-	305.37	16.26
• Pellet Cooler #1	All	-	0.035	0.035	-	-	316.48	17.47
• Pellet Cooler #2	All	-	0.035	0.035	-	-	316.48	17.47
• Pellet System Fines	All	-	0.009	0.009	-	-	305.37	15.12
GNP Paper East								
• Boiler #1	All	-	-	-	12.43	-	450.00	8.93
• Boiler #2	All	-	-	-	12.43	-	450.00	8.93
• Boiler #3	All	-	-	-	25.09	-	450.00	17.09
BASELINE – 1987								
Thermogen								
• No sources existed in the 1987 baseline year; no baseline credit to be taken.								
BASELINE – 1977								
Thermogen								
• No sources existed in the 1977 baseline year; no baseline credit to be taken.								

C. Single Source Modeling Impacts

AERMOD-PRIME refined modeling was performed for a total of three operating scenarios that represented a range of normal operations. Modeling results for Thermogen alone are shown in Table III-4. It is important to note that predicted impacts for all pollutants/averaging periods are based on the highest-first-high (H1H) concentration from all five years of meteorological data. Therefore, the results are overly conservative.

Maximum predicted impacts that exceed their respective significance level are indicated in boldface type. No further modeling was required for pollutant/terrain combinations that did not exceed their respective significance levels.

TABLE III-4: Maximum AERMOD-PRIME Impacts from Thermogen Alone

Pollutant	Averaging Period	Max Impact[a] ($\mu g/m^3$)	Receptor UTM E (m)	Receptor UTM N (m)	Receptor Elevation (m)	Class II Significance Level ($\mu g/m^3$)
SO_2	1-hour	**12.80**	523,100	5053,500	183.80	**10[b]**
	3-hour	8.86	523,000	5053,600	181.74	**25**
	24-hour	2.59	523,152	5054,466	122.98	**5**
	Annual	0.24	523,360	5054,620	105.31	**1**
PM_{10}	24-hour	**8.58**	523,340	5054,660	105.11	**5**
	Annual	**1.76**	523,340	5054,640	105.17	**1**
$PM_{2.5}$	24-hour	**7.08**	523,340	5054,660	105.11	**none[c]**
	Annual	**1.44**	523,340	5054,640	105.17	**none[c]**
NO_2	1-hour	**98.29**	523,100	5053,500	183.80	**10[b]**
	Annual	**3.10**	523,360	5054,620	105.31	**1**
CO	1-hour	57.74	523,100	5053,500	183.80	**2000**
	8-hour	21.27	523,340	5054,700	106.19	**500**

[a] Values based on the H1H (highest-1st-high) concentration from five years of meteorological data
[b] Interim Significant Impact Level (SIL) adopted by Maine
[c] Previous Significant Impact Levels (SIL) remanded by USEPA in 2013

D. Combined Source Modeling Impacts

For predicted modeled impacts from Thermogen alone that exceeded significance levels, as indicated in boldface type in Table III-4, other sources not explicitly included in the modeling analysis must be accounted for by using representative background concentrations for the area.

Background concentrations, listed in Table III-5, are derived from representative rural background data for use in the Eastern Maine region.

TABLE III-5: Background Concentrations

Pollutant	Averaging Period	Background Concentration ($\mu g/m^3$)	Date	Monitoring Site
SO_2	1-hour	24	2009-2011	Presque Isle
	3-hour	18	2009-2011	Acadia National Park
	24-hour	11		
	Annual	1		
PM_{10}	24-hour	20	2011-2013	Acadia National Park
	Annual	10		
$PM_{2.5}$	24-hour	17	2008-2010	Greenville
	Annual	5		
NO_2	1-hour	43	2009-2012	Presque Isle
	Annual	4	2010-2012	
CO	1-hour	365	2010-2012	Acadia National Park
	8-hour	322		

The Department examined other area sources whose impacts would be significant in or near Thermogen's significant impact area. Due to the Thermogen's location, extent of the significant impact area and other nearby source emissions, the Department has determined that one additional source would be considered for combined source modeling: Great Northern Paper (GNP), located in East Millinocket.

For pollutant averaging periods that exceeded significance levels, the maximum modeled impacts were added with conservative rural background concentrations to demonstrate compliance with NAAQS, as shown in Table III-6.

The predicted maximum concentrations for each pollutant listed in Table III-6 have been normalized to the form of the respective standard.

Because impacts for all pollutants using this method meet all NAAQS, no further modeling analyses need to be performed.

TABLE III-6: Maximum Predicted Combined Source Impacts with Background

Pollutant	Averaging Period	Max Impact (μg/m³)	Receptor UTM E (m)	Receptor UTM N (m)	Receptor Elevation (m)	Back-Ground (μg/m³)	Total Impact (μg/m³)	NAAQS (μg/m³)
SO_2	1-hour	**5.35**	-	-	-	24	29.35	196
	3-hour	8.86	523,000	5053,600	181.74	18	26.86	1,300
	24-hour	2.59	523,152	5054,466	122.98	11	13.59	365
	Annual	0.24	523,360	5054,620	105.31	1	1.24	80
PM_{10}	24-hour	**7.81**	523,340	5054,660	105.11	20	27.81	150
	Annual	**1.76**	523,340	5054,640	105.17	10	11.76	50
$PM_{2.5}$	24-hour	**6.17**	523,340	5054,640	105.17	17	23.17	35
	Annual	**1.44**	523,340	5054,640	105.17	5	6.44	12
NO_2	1-hour	**93.93**	-	-	-	43	136.93	188
	Annual	**3.21**	523,360	5054,620	105.31	4	7.21	100
CO	1-hour	57.74	523,100	5053,500	183.80	365	422.74	40,000
	8-hour	21.27	523,340	5054,700	106.19	322	343.27	10,000

E. Secondary Formation of $PM_{2.5}$

Since proposed $PM_{2.5}$ emissions for Thermogen are greater than 15 tons per year and SO_2/NO_x emissions are expected to be greater than 40 tons per year, a qualitative review of secondary impacts due to $PM_{2.5}$ precursor emissions (secondary $PM_{2.5}$) is required. In accordance with *Guidance for $PM_{2.5}$ Permit Modeling* (USEPA 454/B-14-001, 2014), a $PM_{2.5}$ compliance demonstration must account for both primary $PM_{2.5}$ from a source's direct PM emissions, as well as secondarily formed $PM_{2.5}$ from a source's precursor emissions of NO_x and SO_2.

A detailed qualitative assessment of secondary formation was submitted which analyzed the following factors: fuels being used at Thermogen, atmospheric and meteorological conditions, existing background air quality data, $PM_{2.5}$ speciation, quantity of NO_x and SO_2 precursor emissions and the physical/temporal alignment at predicted maximum impacts from the AERMOD-PRIME modeling.

Based on the data presented in the $PM_{2.5}$ qualitative assessment addressing secondary formation, MEDEP-BAQ has determined that no significant secondary $PM_{2.5}$ formation is likely to occur. Therefore, no additional review of NO_x and SO_2 precursor emissions, in relation to NAAQS or Class II increment modeling, is required.

F. Increment

AERMOD-PRIME refined modeling was performed to predict the maximum Class II increment impacts. Thermogen did not exist during the 1977, 1987 or 2010 baseline years, so the SO_2, PM_{10}, NO_2 and $PM_{2.5}$ emissions are considered to be entirely increment consuming. In addition, Thermogen conservatively assumed no credit would be taken from any other sources that existed during the baseline years.

Results of the Class II increment analysis are shown in Table III-7. All modeled maximum increment impacts were below all increment standards. Because all predicted increment impacts meet increment standards, no further Class II increment modeling needed to be performed.

TABLE III-7: Class II Increment Consumption

Pollutant	Averaging Period	Max Impact (μg/m^3)	Receptor UTM E (km)	Receptor UTM N (km)	Receptor Elevation (m)	Class II Increment (μg/m^3)
SO_2	3-hour	5.49	523,100	5053,600	182.28	**512**
	24-hour	2.18	523,550	5054,583	107.83	**91**
	Annual	0.24	523,360	5054,620	105.31	**20**
PM_{10}	24-hour	7.81	523,340	5054,660	105.11	30
	Annual	1.76	523,340	5054,640	105.17	17
$PM_{2.5}$	24-hour	6.17	523,340	5054,640	105.17	9
	Annual	1.44	523,340	5054,640	105.17	4
NO_2	Annual	3.10	523,360	5054,620	105.31	25

Federal guidance and 06-096 CMR 115 require that any major new source or major source undergoing a major modification provide additional analyses of impacts that would occur as a direct result of the general, commercial, residential, industrial and mobile-source growth associated with the construction and operation of that source.

GENERAL GROWTH: Some increases in local emissions due to construction related activities are expected to occur for several months, with the majority of emissions due to truck traffic (soil removal, concrete delivery/pouring, delivery of materials, etc.). Increases in potential emissions of NO_x and $PM_{2.5}$ due to commuting by construction workers will likely be temporary and short-lived. Emissions of dust from construction related activities will be minimized by the use of "Best Management Practices" for construction on-site.

RESIDENTIAL, COMMERCIAL AND INDUSTRIAL GROWTH: Population growth in the impact area of the proposed source can be used as a surrogate factor for the growth in emissions from residential combustion sources. Construction of Thermogen is expected to create approximately 25 new full-time jobs. The manpower requirements, operations and support required for the construction and operation of Thermogen will, for the most part, be available from the surrounding communities. It is expected that no new significant residential, commercial and industrial growth will follow from the modification associated with this source.

MOBILE SOURCE AND AREA SOURCE GROWTH: Since area and mobile sources are considered minor sources of NO_2, their contribution to increment has to be considered. Technical guidance from USEPA points out that screening procedures can be used to determine whether additional detailed analyses of minor source emissions are required. Compiling a minor source inventory may not be required if it can be shown that little or no growth has taken place in the impact area of the proposed source since the baseline dates (1977/1988) were established. Very little growth has taken place in the area of Thermogen since the baseline dates were established. In addition, no increase in Vehicle Miles Travelled (VMT) is expected as a result of the modification. No further analyses of mobile or area source growth are needed.

G. Impacts on Plants, Soils & Animals

In accordance with guidance provided in USEPA's Prevention of Significant Deterioration manual, Thermogen evaluated the impacts of its emissions using procedures described in *A Screening Procedure for the Impacts of Air Pollution on Plants, Soils and Animals* (USEPA, 450/2-81-078, 1980).

Maximum predicted impacts from the AERMOD-PRIME modeling were compared to USEPA's 'Screening Concentrations' (see Table III-8), which represent the minimum concentration at which adverse growth effects or tissue injury in sensitive vegetation can be expected. For comparison to the Screening Concentrations, the model impacts for all pollutants/averaging periods were conservatively based on the maximum High-1st-High predicted values.

TABLE III-8 : Maximum Impacts on Plants, Soils & Animals ($\mu g/m^3$)

Pollutant	Averaging Period	Max Impact ($\mu g/m^3$)	Screening Concentration ($\mu g/m^3$)
SO_2	1-hour	12.80	917
	3-hour	8.86	786
	Annual	0.24	18
NO_2	4-hour	25.00	3,760
	8-hour	21.40	3,760
	Month	21.40*	564
	Annual	3.10	94
CO	Week	57.74*	1,800,000

* = 8-hour NOx impact and 1-hour CO impact used a conservative surrogate value for atypical averaging periods

Because all predicted impacts are below the Screening Concentrations, no further assessment of the impacts to plants, soils and animals is required, per USEPA guidance.

H. Class I Impacts

Based upon the magnitude of proposed emissions increase and the distance from the source to any Class I area, the affected Federal Land Managers (FLMs) and MEDEP-BAQ have determined that an assessment of Class I Air Quality Related Values (AQRVs) is not required.

I. Summary

In summary, it has been demonstrated that Thermogen will not cause or contribute to a violation of any NAAQS for SO_2, PM_{10}, $PM_{2.5}$, NO_2 or CO; or any SO_2, PM_{10}, $PM_{2.5}$ or NO_2 Class II increment standards.

ORDER

Based on the above Findings and subject to conditions listed below, the Department concludes that the emissions from this source:

- will receive Best Practical Treatment,
- will not violate applicable emission standards, and
- will not violate applicable ambient air quality standards in conjunction with emissions from other sources.

The Department hereby grants Air Emission License A-1072-77-3-A subject to the conditions found in Air Emission License A-1072-77-1-N and amendment A-1072-77-2-A, and in the following conditions.

Severability. The invalidity or unenforceability of any provision, or part thereof, of this License shall not affect the remainder of the provision or any other provisions. This License shall be construed and enforced in all respects as if such invalid or unenforceable provision or part thereof had been omitted.

SPECIFIC CONDITIONS

Conditions (16) and (17) in air emission license A-1072-77-1-N (September 24, 2012) and replacement condition (16)(I) in air emission license A-1072-77-2-A (May 22, 2013) shall be deleted. These conditions addressed the previously proposed Torrefication Process and Pellet Mill.

The following shall update Condition (18) in air emission license A-1072-77-1-N:

(18) **Offsets**

97.99 tons of the offset credits previously certified and currently available as set forth in Thermogen license A-1072-77-1-N and GNP West Inc. and Great Northern Paper Company, LLC license A-406-77-4-O, shall be utilized by Thermogen to offset the 85.02 tons of VOC licensed emissions at a 1.15 to 1 ratio. [06-096 CMR 113 and Air Emission Licenses A-1072-77-1-N and A-406-77-4-O].

The following shall replace Condition (20) in air emission license A-1072-77-1-N:

(20) **Fugitive Emissions**

A. The transfer of raw material and finished product shall take place under covered conveyors and covered loading stations. [06-096 CMR 115, BACT]

B. Visible emissions from a fugitive emission source (including stockpiles and roadways) shall not exceed an opacity of 20%, except for no more than five (5) minutes in any 1-hour period. Compliance shall be determined by an aggregate of the individual fifteen (15)-second opacity observations which exceed 20% in any one (1) hour. [06-096 CMR 101]

New Conditions:

(24) **Rotary Dryer with Pulverized Wood Burner and Thermal Treatment Process**

A. Fuel

The Rotary Dryer's Pulverized Wood Burner shall fire dried pulverized wood as the primary fuel during normal operations, with the use of propane or compressed natural gas allowed during startup and stabilization periods.

[06-096 CMR 115, BACT, LAER, MACT]

B. Rotary Dryer/Pulverized Wood Burner and Thermal Treatment Process Control Requirements

1. Rotary Dryer/Burner

a. The Rotary Dryer shall be equipped with flue gas recirculation.
b. A temperature monitoring system shall be installed, operated, maintained, and calibrated on the Rotary Dryer in accordance with the manufacturer's recommendation.

c. Emissions from the Rotary Dryer and Pulverized Wood Burner shall be directed through the cyclones, WESP, and regenerative thermal oxidizer, exhausting out stack #1 (excluding the FGR portion of the Rotary Dryer exhaust).

[06-096 CMR 115, BACT, LAER, MACT]

2. Thermal Treatment Process

Exhaust from the Thermal Treatment Pressure Vessels shall be directed through the Blow Tank, associated cyclones, WESP, and RTO, exhausting out Stack #1.

[06-096 CMR 115, BACT, LAER, MACT]

3. WESP

Temperature and secondary voltage systems shall be installed, operated, maintained, and calibrated on the WESP in accordance with the manufacturer's recommendation. [06-096 CMR 115, BACT, LAER, MACT]

4. RTO

a. A temperature monitoring system shall be installed, operated, maintained, and calibrated on the RTO in accordance with the manufacturer's recommendation.
b. Fuel use for the RTO shall be included with the Steam Boiler fuel limit. See Conditions 25(A)(2) & (3).

[06-096 CMR 115, BACT, LAER, MACT]

C. Emissions from Stack #1 shall not exceed the following

Pollutant	Stack #1 (post WESP and RTO)	Origin and Authority
PM (filterable)	3.85 lb/hr	06-096 CMR 115, BACT, MACT
PM_{10} (total: filterable and condensable)	3.85 lb/hr	06-096 CMR 115, BACT
$PM_{2.5}$ (total: filterable and condensable)	3.85 lb/hr	06-096 CMR 115, BACT
SO_2	4.0 lb/hr	06-096 CMR 115, BACT
NO_X	30.72 lb/hr	06-096 CMR 115, BACT
CO	18.05 lb/hr	06-096 CMR 115, BACT, MACT
VOC	17.56 lb/hr	06-096 CMR 115, LAER, MACT

D. Visible emissions from Stack #1 shall not exceed 20% opacity on a 6-minute block average, except for no more than one 6-minute block average in a 1-hour period of not more than 40% opacity. [06-096 CMR 115, BACT]

E. Dryer Production Limitation

1. The Rotary Dryer shall not exceed a processing rate of 458,000 oven dried tons per year of material processed through the dryer on a 12-month rolling total, as dryer output.

2. Rotary Dryer process rate records shall be maintained on a monthly and 12-month rolling total basis. The processing rate shall be calculated using dryer inlet metering and moisture content.

[06-096 CMR 115, BACT, LAER]

F. Stack Height

Stack #1 shall be at least 150 above ground level. [06-096 CMR 115, BACT]

G. Stack Testing

Within 180 days of commencing operation, Thermogen shall perform stack tests on Stack #1 for PM, PM_{10}, $PM_{2.5}$, NO_X, CO and VOC to determine compliance with the licensed emission limits using the EPA stack test methods specified in the table below, or other methods approved by the Department. [06-096 CMR 115, BACT]

Pollutant	**EPA Test Method**
PM	Method 5
PM_{10}	Method 5, Method 201 or 201A
$PM_{2.5}$	Method 202
NO_X	Method 7E
CO	Method 10
VOC	Methods 18 & 25A

H. Submittals

Within 90 days of performing the required stack testing, Thermogen shall submit the following to the Department:

1. Documentation of Rotary Dryer operating temperature parameter values and monitor details, including the frequency of collected data points and recordkeeping. The operating temperature parameters shall ensure proper operating conditions of the dryer.

2. A plan detailing emissions control equipment operating and maintenance procedures and parameters, including applicable compliance indicators and values/ranges, monitoring approach and frequency, quality assurance practices and criteria, recordkeeping methods and inspections and testing to the Department for approval for the following:
   a. the dryer FGR system, including fuel feed rate, combustion chamber oxygen concentration and FGR damper position;
   b. the RTO, including minimum combustion chamber operating temperature; and
   c. the WESP, proposed to include secondary voltage, quench inlet temperature, quench water flow rate and/or pressure, and WESP outlet temperature.

[06-096 CMR 115, BACT]

I. Applications

1. Following the submittal of the plans required in Condition 24(H) and after notification from the Department, Thermogen shall submit a license application to incorporate the specifics the dryer's operating temperature parameters and the RTO and WESP parameter requirements into the license, as appropriate. [06-096 CMR 115, BACT]

2. A startup, shutdown, and malfunction plan detailing emissions, procedures, and timeframes for these events shall be included with the submittal of the Part 70 license application, required within 12 months of commencing operation. [06-096 CMR 115, BACT]

(25) **Steam Boiler**

A. Fuel

1. Natural gas shall be fired in the Steam Boiler.

2. Total fuel use for the Steam Boiler and the Regenerative Thermal Oxidizer shall not exceed 380 MMBtu/yr of natural gas, based on a 12 month rolling total basis.

3. Thermogen shall install and utilize a fuel flow meter to demonstrate compliance with the natural gas annual fuel limit. Records of annual fuel use shall be kept on a monthly and 12-month rolling total basis.

[06-096 CMR 115, BACT]

B. Steam Boiler Control Requirements

The Steam Boiler shall be equipped and operated with a low NO_X burner and flue gas recirculation to minimize emissions. [09-960 CMR 115, BACT]

C. Emissions shall not exceed the following [06-096 CMR 115, BACT]:

	PM (lb/hr)	PM_{10} (lb/hr)	$PM_{2.5}$ (lb/hr)	SO_2 (lb/hr)	NO_x (lb/hr)	CO (lb/hr)	VOC (lb/hr)
Steam Boiler (42.6 MMBtu/hr)	0.3	0.3	0.3	0.026	1.53	1.55	0.21

Compliance with the Steam Boiler emission limits shall be based on stack tests performed upon request of the Department. [09-960 CMR 115, BACT]

D. Visible emissions from the Steam Boiler shall not exceed 10% opacity on a 6-minute block average basis. [06-096 CMR 115, BACT]

E. 40 CFR Part 60, Subpart Dc
Thermogen shall comply with all requirements of 40 CFR Part 60, Subpart Dc applicable to the Steam Boiler including, but not limited to notification, recordkeeping, and reporting requirements.

F. 40 CFR Part 63, Subpart DDDDD

Thermogen shall comply with all requirements of 40 CFR Part 63, Subpart DDDDD applicable to the Steam Boiler including, but not limited to, work practice standards (five year tune-up if a continuous O_2 trim system is used or an annual tune-up if no O_2 trim system is used), notification, recordkeeping and reporting requirements.

(26) **Pellet Mills and Pellet Coolers**

A. Pellet Mills and Pellet Coolers Control Requirements

1. The Pellet Mills' aspiration air shall be routed through a fabric filter to the Rotary Dryer's Pulverized Wood Burner.

2. The fabric filter for the Pellet Mills aspiration air shall be properly maintained and pressure drop shall be monitored minimally once per shift. Compliance records shall be kept documenting routine and unplanned maintenance on the fabric filter, including dates, times, and tasks performed.

3. The Pellet Coolers shall be controlled though the use of high efficiency cyclones.

4. The cyclones for the Pellet Coolers shall be properly maintained and shall be inspected visually once per day (24 hour period). Compliance records shall be kept documenting visual inspections and routine and unplanned maintenance on the cyclones, including dates, times, and tasks performed.

[06-096 CMR 115, BACT]

B. Emissions from the Pellet Coolers shall not exceed the following [06-096 CMR 115, BACT]:

Pollutant	Pellet Coolers 1 and 2 (from each cyclone)
PM (filterable)	2.75 lb/hr
PM_{10} (total: filterable and condensable)	0.275 lb/hr
$PM_{2.5}$ (total: filterable and condensable)	0.137 lb/hr
VOC	1.33 lb/hr

C. Visible emissions from each of the Pellet Cooler cyclones shall not exceed 20% opacity on a 6-minute block average basis, except for no more than one 6-minute block average in a 1-hour period of not more than 40% opacity. [06-096 CMR 101]

D. Pellet Production Limitation

Thermogen shall not exceed a final product production rate of 387,805 ODT/yr of pellets based on a 12-month rolling total, as measured at the rail car loading operations. Production records shall be maintained on a monthly and 12-month rolling total basis. [06-096 CMR 115, BACT]

E. Stack Testing

Within 180 days of commencing operation, Thermogen shall perform stack testing on one of the Pellet Cooler stacks for VOC to determine compliance with the licensed emission limits using the EPA stack test methods specified in the table below, or other methods approved by the Department. [06-096 CMR 115, BACT]

Pollutant	EPA Test Method
VOC	Methods 18 & 25A

(27) **Fuel Hammermill Aspiration, Dry Chips Pneumatic Transfer System, and Pellet System Fines Transfer**

A. The Fuel Hammermill Aspiration, the Dry Chips Pneumatic Transfer System, and the Pellet System Fines Transfer shall each be controlled with a fabric filter. [06-096 CMR 115, BACT]

B. Visible emissions from each of the fabric filters shall not exceed 10% opacity on a 6-minute average basis, except for no more than one 6-minute block average in a 1-hour period of not more than 40% opacity. The facility shall take corrective action if visible emissions from the fabric filters exceed 5% opacity. [06-096 CMR 115, BACT]

C. The fabric filters shall be properly maintained and pressure drop shall be monitored and recorded minimally once per shift. Compliance records shall be kept documenting routine and unplanned maintenance on the fabric filter, including dates, times, and tasks performed. [09-096 CMR 115, BACT]

(28) **Emergency Generator**

A. The emergency generator shall be limited to 100 hours of operation per calendar year, excluding operating hours during emergency situations. [06-096 CMR 115]

B. Emissions shall not exceed the following [06-096 CMR 115, BPT]:

Unit	PM (lb/hr)	PM_{10} (lb/hr)	$PM_{2.5}$ (lb/hr)	SO_2 (lb/hr)	NO_x (lb/hr)	CO (lb/hr)	VOC (lb/hr)
Emergency Generator (2.68 MMBtu/hr) distillate fuel	0.14	0.14	0.14	0.004	2.88	2.19	0.04

C. Visible Emissions
Visible emissions from the Emergency Generator shall each not exceed 20% opacity on a six (6) minute block average, except for no more than two (2) six (6) minute block averages in a continuous 3-hour period of not more than 40% opacity. [06-096 CMR 115, BACT]

D. The Emergency Generator shall meet the applicable requirements of 40 CFR Part 60, Subpart IIII, including the following:

1. Manufacturer Certification
The generator shall be certified by the manufacturer as meeting the emission standards for new nonroad compression ignition engines found in §60.4202. [40 CFR §60.4205(b)]

2. Ultra-Low Sulfur Fuel
The fuel fired in the generator shall not exceed 15 ppm sulfur (0.0015% sulfur). Compliance with the fuel sulfur content limit shall be based on fuel records from the supplier documenting the type of fuel delivered and the sulfur content of the fuel. [40 CFR §60.4207(b) and 06-096 CMR 115]

3. Non-Resettable Hour Meter
A non-resettable hour meter shall be installed and operated on the generator. [40 CFR §60.4209(a)]

4. Annual Time Limit for Maintenance and Testing
   a. The generator shall be limited to 100 hours/year for maintenance checks and readiness testing, emergency demand response, and periods of voltage or frequency deviation from standards. Up to 50 hours/year of the 100 hours/year may be used in non-emergency situations (this does not include peak shaving, non-emergency demand response, or to generate income for a facility by providing power to an electric grid or otherwise supply power as part of a financial arrangement with another entity unless the conditions in §60.4211(f)(3)(i) are met). These limits are based on a calendar year. Compliance shall be demonstrated by a written log of all generator operating hours. [40 CFR §60.4211(f) and 06-096 CMR 115]

   b. Thermogen shall keep records that include maintenance conducted on the generator and the hours of operation of the engine recorded through the non-resettable hour meter. Documentation shall include the hours spent for emergency operation, including what classified the operation as emergency and how many hours spent for non-emergency. If the generator is operated during a period of demand response or deviation from standard voltage or frequency, or to supply power during a non-emergency situation as part of a financial arrangement with another entity as specified in §60.4211(f)(3)(i), Thermogen shall keep records of the notification of the emergency situation, and the date, start time, and end time of generator operation for these purposes.

5. Operation and Maintenance

   The generator shall be operated and maintained according to the manufacturer's emission-related written instructions or procedures developed by Thermogen that are approved by the engine manufacturer. Thermogen may only change those emission-related settings that are permitted by the manufacturer. [40 CFR §60.4211(a)]

6. Annual Reporting For Demand Response Availability Over 15 Hours Per Year (for generators greater than 100 brake hp)

   If Thermogen operates or is contractually obligated to be available for more than 15 hours per calendar year in a demand response program, during a period of deviation from standard voltage or frequency, or supplying power during a non-emergency situation as part of a financial arrangement with another entity as specified in §60.4211(f)(3)(i), the facility shall submit an annual report containing the information in §60.4214(d)(1)(i) through (vii). The first annual report must cover the calendar year 2015 and must be submitted no later than March 31, 2016. Subsequent annual reports for each calendar year must be submitted no later than March 31 of the following calendar year. The annual report must be submitted electronically using the Compliance and Emissions Data Reporting Interface (CEDRI) that is accessed through EPA's Central Data Exchange (CDX) (www.epa.gov/cdx). However, if the reporting form is not available in CEDRI at the time that the report is due, the written report must be submitted to the following address:

U.S. Environmental Protection Agency, Region I
5 Post Office Square, Suite 100 (OES04-2)
Boston, MA 02109-3912
Attn: Air Compliance Clerk

[40 CFR §60.4214(d)]

(29) Thermogen shall apply for a Part 70 license within 12 months of commencing operation under the proposed scenario as provided in 40 CFR Part 70.5. [06-096 CMR 140, Section 3]

DONE AND DATED IN AUGUSTA, MAINE THIS 3rd DAY OF June , 2015.

DEPARTMENT OF ENVIRONMENTAL PROTECTION

BY: Heather Parent For
PATRICIA W. AHO, COMMISSIONER

PLEASE NOTE ATTACHED SHEET FOR GUIDANCE ON APPEAL PROCEDURES

Date of initial receipt of application: June 13, 2014
Date of application acceptance: June 17, 2014

Date filed with the Board of Environmental Protection:

This Order prepared by Kathleen E. Tarbuck, Bureau of Air Quality.

Filed
JUN 03 2015
State of Maine
Board of Environmental Protection